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PLATE I

1. Everes comyntas

2. Cyaniris pseudargiolus violacea

3. Enodia portlandia

4. Cyaniris pseudargiolus neglecta

5. Cyaniris pseudargiolus lucia

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PREFACE

Butterflies have often been compared fancifully to flowers. They are certainly like them in that each kind has its own season for appearing in perfect bloom; and thus they together variegate the landscape in the open season of the year. More than any other insects they attract in the country the attention of every city visitor, who often finds it difficult to learn what may be known by naturalists of these wayward wanderers, seeking honey from the clover, the milkweed, the thistle, or the goldenrod.

In the following pages, therefore, I have endeavored to relate the story of the sometimes simple, sometimes curiously complex lives of our very commonest butterflies, those which every rambler at all observant sees about him at one time or another, inciting his curiosity or pleasing his eye. The sequence of the stories is mainly that of the order of appearance of the different subjects treated, modified only by the occasional substitution of a later appearance for the first, when the butterfly is double or triple brooded. In a general way, therefore, it follows the order of the season.

As illustrations are also furnished of each butterfly here discussed, descriptions are given only in the briefest and most general terms. Closer identifications must be sought in the author's previous works, and in particular, as in some sense complementary to this, his "Guide to the Commoner Butterflies of the Northern United States and Canada" may be mentioned.

Most of the illustrations given here have been used in the author's previous works; but a number of them have been engraved expressly for this volume by the skillful hand of Mrs. Anna Botsford Comstock.

CAMBRIDGE, *April* 13, 1899.

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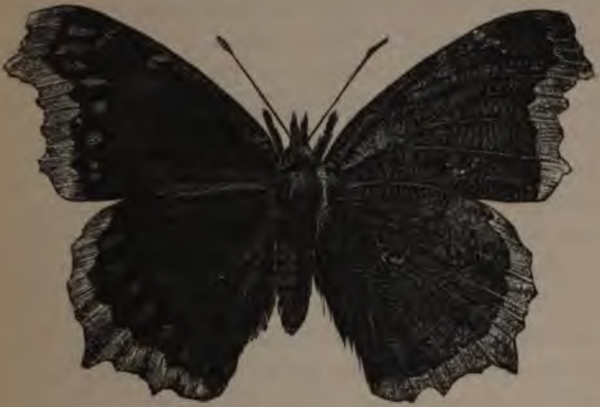


EVERY-DAY BUTTERFLIES

EUVANESSA ANTIOPA — THE MOURNING-CLOAK

Wandering in open groves, while the trees are still bare of leaf, say in March, or even in warm and sunny days in February, one is occasionally startled by the sight of a large, dark butterfly flitting carelessly about as if spring were at hand or were actually come. On rare occasions it has been seen at even an earlier date, and has been recorded in flight in every winter month in our northern States. It is our earliest butterfly, venturing from its winter quarters with more freedom than any other hibernating kind. Every one knows it, — this large, purplish-brown butterfly, having a spread of three inches or more, with a broad buff-yellow margin to its wings, near the inner edge of which, on the darkest groundwork of the wings, is a row of pale blue spots, seen only on the upper surface; while, beneath, the wings are brown, cross-threaded minutely and tremulously with black, the buff margin paler than above.

Winter seems a treacherous time for such frail creatures as butterflies, yet there are not a few kinds which, in so severe a winter climate as that of our northern States or Canada, brave the perils of this season in crannies of one sort and another, beneath piles of rocks, in hollow places in the trunks of trees, especially near the roots, beneath the rafters or in the cellars of old buildings, barns, or outhouses, in corded wood in the forest, or in open drains.

All our Vanessini, to which the Mourning-cloak belongs, hibernate in the butterfly state, and I was once able to follow the winter movements of one of this species which flew into the cellar of my laboratory about the middle of November, and took up its station beneath the projecting tread of one of the stairs, up and down which I passed many times a day without disturbing it. By marking on the stair the position of the projecting wings, I was able to note that it shifted its position half a dozen times in the course of the winter, but always within the range of an inch. It finally flew to the wall of the cellar on the last day of

February, and in less than a week thereafter bade me good-by.

In a general way one may also say that the hibernating butterflies of our northern States are confined to the Vanessini, for the only other species known to pass the winter as butterflies are really southern insects, which extend to a greater or less degree into the northern States, but do not properly form a distinctive or characteristic part of our fauna. Such are *Anosia plexippus*, *Hypatus bachmanii*, *Callidyas eubule*, and *Xanthidia nicippe*. In no part of the temperate regions of the world is a single butterfly of the great families Lycænidæ and Hesperidæ known to pass the winter in its perfect state.

But to return to our Mourning-cloak. After flying for some weeks in the leafless woods, when the only nourishment they can find is in the exuding sap of some injured tree, the butterflies mate, and after a time begin to lay eggs. They pair by the middle of April, and lay their eggs early in May, in clusters, on the terminal twigs of the elm, willow, etc.

There are not many of our butterflies that lay their eggs in clusters, and of these none lay an attractive mass except this butterfly, which ordinarily places them, with extreme regularity, in rows side by side around a twig, completely, or almost completely, girdling it. This is done wholly by feeling about for the proper place with the tip of the abdomen, and laying an egg every twelve to twenty seconds without moving more than necessary to do it. In rare instances they may be laid upon the under side of a leaf in rows side by side, but those of the first brood are usually laid when the leaves are but just bursting, or indeed earlier. There may be anywhere from a dozen to a hundred or more in a cluster.

These eggs hatch in from twelve to sixteen days, according to the temperature of the season, the caterpillars biting their way out of the top and hastening at once to the nearest leaf, where they range themselves side by side in compact rows, their heads at the edge of the leaf, which they at once begin to devour. They remain in company all their life, though as they grow older they scatter a little, always to the nearest leaves, so that an entire branch of a tree may be defoliated by them, while the neighboring branches may escape injury. When nearly full grown, their united weight may perceptibly cause the branch to droop. They make no attempt at concealment.

They grow to the length of two inches, and are black, minutely dotted with white, with a row of eight large red spots down the middle of the back, and bristle with long, branching black spines. They feed upon willows, poplars, and elms, as well as occasionally on allied plants, but these are their favorites.

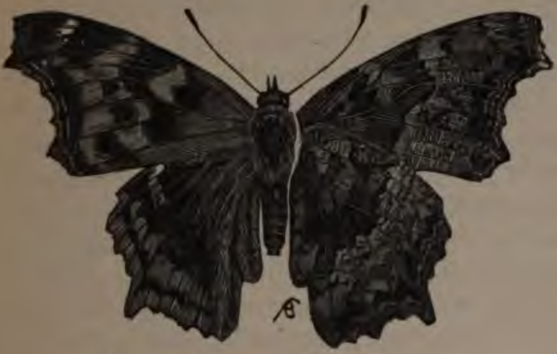
About the last of June one may find them, full fed, scurrying along singly in a dreadful hurry, trying to find a good place in which to hang as a chrysalis. The under side of fence rails or some similar place is chosen; the chrysalis — which is an angular, short-spined object about the color of a weather-beaten board — hangs from eight to twelve days, and early in July, sometimes as early as the last of June, just after the last of the battered hibernating butterflies has disappeared, a new brood begins to make its appearance.

This history is then again repeated, with slight modifications. By the middle of July eggs are again being laid, and in the first week in September the earliest butterflies of still another brood begin to appear, and continue to emerge from the chrysalis for a month, and to fly until some time into November, when they gradually seek hiding-places for hibernation. In the far north there is but a single brood, appearing on the wing in August.

The butterfly is found all over the United States and in Mexico and Guatemala, but is very rare in the south and central plateau region of our west. It flies everywhere, but is addicted to groves or sunny nooks in woods. It is also found throughout the north temperate region of the Old World, though now extremely rare in England, where it is known by the local name of Camberwell Beauty.

Its flight is strong and nimble. It makes two or three light flutters in quick succession, then sails a short distance in an irregular and broken course; beats its wings again, and thus pursues its way. It loves to return to a place whence it has flown, flying and sailing easily round and round in gradually narrowing and descending circles from a height of five or ten feet, and finally settling upon the identical spot it had quitted, even when there is no apparent cause for attraction. I once observed a specimen late in February from the deck of a vessel full twenty miles from land, off Lookout Shoals, North Carolina.

Whether the butterfly originated in Europe or America is a matter open to doubt. A curious fact, lending aid to the theory of its recent introduction into the Old World, is given by Dr. Behr, of California, who writes that "old missals decorated by monks in mediæval times with lifelike insects and flowers show frequently *V. io*, but never *V. antiopa*, whose striking beauty certainly would have inspired the mediæval college Father with the same desire to ornament with its figure the missal under his hands."



EUGONIA J-ALBUM — THE COMPTON TORTOISE

THIS is the largest of our butterflies with ragged-edged wings. These have an expanse of two and a half inches or more. They are of a tawny ground color above, much marked with bars and blotches of dark brown, especially next the front margin, with a smaller white bar (largest on the hind wing) near the tip. Beneath, they are excessively variegated, but, in general, brown on the basal, ashen on the apical half, with a sometimes indistinct, slender, white L in the middle of the hind wings.

It is regarded by some naturalists as identical with a European species, *E. vau-album*, or, at most, as a mere variety of it. This is completely negatived by the caterpillar, which in the American form is green when mature, with only the most indistinct markings, while the European is broadly and distinctly banded longitudinally; but the butterflies are unquestionably very similar, though they may be distinguished by careful comparison.

There are a few, though only a few, butterflies common to Europe and North America. They are hardly more than a dozen in number, if as many, if we omit the high northern species which have a circumpolar range and do not extend southward even into the northern United States. There are perhaps half a dozen more which, like our present species, have been regarded by some naturalists as identical with European forms, but which on careful comparison may be distinguished from them. They are doubtless the descendants of some one form in its time common to the two continents, or which passed in some way from one to the other, and whose descendants have since diverged. Probably those species now uniformly regarded as the same are on their way to a similar divergence, when they shall have been longer kept apart. The degree of divergence, in short, is to a certain extent the measure of the time elapsed since their separation.

Is it possible to determine, with regard to these two classes, — those which are identical and those which are very intimately allied, — on which continent they originated? Naturalists judge of such a question, in part at least, by a study of the present distribution of the species of any given genus. Thus Eugonia, our present genus, is represented in America by this species, found in a broad belt crossing the continent near the northern boundary of the United States, and by a second found only on the Pacific coast; while in the Old World, in a similar belt, from the Atlantic to the Pacific, are at least three distinct species: this renders it probable, though not very probable, that the Old World is the mother country. Or, to take a clearer case where the species are certainly identical in the two worlds, we may cite the genus Vanessa, where two species, *V. cardui* and *V. atalanta*, occur widely in both worlds, *V. cardui* being indeed nearly cosmopolitan. The immediate congeners of this latter species, which belongs to a distinct section from the other, are found altogether in the New World; while those of *V. atalanta* are found exclusively in the Old, rendering it probable that *V. cardui* is an interloper in the Old World (which it has completely overspread), and *V. atalanta* an immigrant in the New World.

The course of migration from one continent to the other is indicated by studying the butterflies of our high North, *i. e.* the twenty-five or thirty species which are found only north of the Canadian border. These belong to thirteen different genera, and every one of these genera is represented in the Old World either by the same or by some allied species. Five of these genera, including a dozen of the species, are confined entirely to the western half of our continent, and show a distinct geographical relation to Alaska, while not a single genus is confined to the eastern half. It seems, therefore, tolerably probable that the interchange of butterfly population between the Old and New Worlds took place by way of Bering Strait.

Eugonia j-album is one of the earliest butterflies to be seen in flight, being scarcely surpassed in this respect by *Euvanessa antiopa.* The earliest record is February 12, and the thermometer at the time 33° F.! It is, however, rarely seen as early as March, or not until the last of the month; becomes common in April, and flies until early in June.

The eggs have never been described, but that they are laid in clusters is certain, because the caterpillars are known to feed in company on white birch. These, when mature, are wholly green, with black spines, but before maturity are more or less longitudinally banded with dark colors. They attain their full growth some time in June, generally about the middle, and hang from eight to thirteen days in chrysalis; this is of a dead-leaf color, and closely resembles that of *Euvanessa antiopa*, but with golden-nacreous spots at the base of some of the spines. The earliest butterflies from these chrysalids appear late in June, but rarely are at all common before the end of the first week in July. Whether these butterflies ever lay eggs the same season or not is uncertain. Probably they do not, but in southern parts of its range there would appear to be time for it. In any case, the butterflies become far more abundant later in the season, and they continue on the wing through October and even into November. The winter is passed in hibernation by the butterflies.

The butterfly is found in high, open woodland, and on hilly roadsides in the vicinity of woods. It is a wary insect, and dashes off at great speed when alarmed; it is fond of pitching with closed wings, head down, on the trunks of large trees, when the colors of the under surface of the wings render it difficult to distinguish it from the gray bark.

Hundreds of specimens of this butterfly flew one warm September night against the lantern of the powerful Sankoty Head Light, Nantucket, giving the keeper a great deal of trouble. Yet in several summers spent on Nantucket I never saw other living specimens there.

CYANIRIS PSEUDARGIOLUS — THE SPRING AZURE

Our next species is a very different butterfly. No one who habitually looks for the earliest hepaticas and violets in the spring but will have noticed, fluttering about the thickets or near the streamlets in the woods, a tiny blue butterfly like a violet afloat; and, if he have caught one under his hat, he cannot fail to have observed the delicacy of the gossamer wings, which his rude handling has quite spoiled. It is the earliest of our butterflies to come from the chrysalis of the same season, and ushers in the spring. (Plate I., Figs. 2, 4, 5.) The upper surface of the wings in the male is pale violet; in the female, much paler violet, broadly margined on the fore wings with brown; beneath, both sexes are alike of a pale ashen-gray, with brown markings, especially on the hind wings, where they vary from a few series of dots to broad and very irregular blotches, covering a large part of the surface. It is, in fact, one of our most highly variable butterflies, and, what is interesting, the variations are very largely dependent upon latitude, and especially upon the time of year; for the butterfly appears again and again in new attire, while it is found from Labrador to Mexico, and from Alaska to Florida; hardly another of our butterflies has so wide a range. It has been necessary to employ a number of varietal terms to distinguish the different forms (formerly thought distinct species), chief among which are those of successive flights (but not necessarily distinct broods) in any given region, in which the markings of the under surface gradually decrease in heaviness as the season advances.

In the extreme north, from Labrador to Alaska, it is single-brooded, but appears in two forms, *lucia* and *violacea*, differing largely in the heaviness of the markings of the under surface; the meagre observations in this region do not show which of these appears there the earlier, but presumably the sequence will be found the same as farther south. Not far from the Canadian border two new phenomena appear: the butterfly becomes double-brooded and trimorphic, and the third form with still lighter markings, of which the second brood is exclusively composed, appears also as a member of the first brood, the three forms succeeding each other at least within a month, in the order of the heaviness of the dark markings of the under surface, viz.: *lucia* (Fig. 5), *violacea* (Fig. 2), *neglecta* (Fig. 4).

Confining our attention for the moment to the first brood, observations would seem to show that in the northern part of the belt of its trimorphism, the form *neglecta* is comparatively rare, but that in proceeding farther and farther south, it becomes proportionally more and more numerous until, about Albany, N. Y., it has altogether usurped in numerical importance the place formerly occupied by *lucia*, which entirely disappears south of New England, except probably in mountainous districts. At the same time the second brood, although apparently not more the product of *neglecta* than of *violacea*, becomes more abundant. We have now reached another belt of country, in which we find the butterfly again dimorphic in the first generation, — *violacea* and *neglecta* in the order of their appearance. But we have not far to pass, say to northern Virginia, before we reach a new condition, in which the first form of the first generation becomes sexually dimorphic, the males appearing under two guises: one blue above, the normal *violacea*, the other dark brown, *violacea-nigra;* and this apparently continues to be the condition of things as far as the species extends southward.

In the extreme west, on the Pacific slope, we have a new form, *piasus*, most resembling *neglecta*, which, as far as observations have gone, appears to be single-brooded in the north, double-brooded in the south, and to show no difference between the broods, — as sharp a contrast as could well be found to the character of the species elsewhere; and it is the more strange, since in the mountains of Arizona an ashen-tinted form of *violacea* appears, to which the varietal name *cinerea* has been given. This form, *piasus*, occurs as far north as central California. What is found to the north of that is not well known. At Vancouver, however, *lucia* and *violacea* are met with, and *violacea* at least in Oregon; and it would seem as if, in the intervening area, not only *lucia* but *violacea* must disappear and leave only the more weakly marked Pacific representative of *neglecta* as the remnant of the polymorphism of the first brood, and which does not become digoneutic until left in possession of the field.

Other instances of polymorphism may easily be cited among our butterflies, but this is perhaps the extremest case of all. This phenomenon occurs only in digoneutic or polygoneutic species, and is therefore largely seasonal; for distinct climatic differences, whether temperature or moisture (or both), are unquestionably the prime cause of seasonal dimorphism, the former in temperate the latter in tropical regions. The first has been practically proved by experiment, the latter by the correspondence of the phenomena to those of temperate climates, and their synchronism with the dry and wet seasons.

In New England, as already stated, the Spring Azure is one of the first butterflies to appear fresh from the chrysalis in the spring. The earliest (form *lucia*) generally appear about the middle of April, and in the first week of May the numbers are materially increased by the advent of the form *violacea;* both fly together through this month, further accompanied, after the middle of May, by the third form, *neglecta*, so that in the last half of the month all may be taken together. In June *lucia* is rarely seen, and the others disappear one after the other: but in July the second brood proper appears, consisting wholly of *neglecta*, and continues to emerge from the chrysalis all through this month; this brood, however, is not so abundant as the preceding, though butterflies may be found even into September.

Open deciduous woods are the favorite haunts of the butterfly, at the borders of which, in their open shade, by the roadsides in their vicinity, or settling in numbers about damp spots, it may be found in abundance. It flies with an uncertain, tremulous, wanton motion, never in a direct course, but often hovering and quivering about one spot, never alighting without seeming very uncertain just where to go. If much alarmed, it will move off more rapidly, but still with the same wayward movement, rarely rising as high as one's head.

The eggs are laid singly on the buds or the calyx of the flowers of the plant on which the caterpillar is to feed, tucked in between the flowers well out of sight; they hatch in from four to eight days, according to the season. They are turban-shaped, pea-green, and studded with pale prominences. The caterpillars are slug-shaped, with a very minute extensile head, the body greenish-white, with a dusky dorsal line and marked with green on the sides, but they vary considerably in color. The plants fed on by the caterpillars are extremely various, those already known belonging to as many as fifteen different families; but their principal food is thought to be Cornus in the early spring, Cimicifuga in June, and Actinomeris later in the season, a plant in, or soon to be in, flower being chosen by the parent. The caterpillars eat buds, flowers, and leaves indiscriminately, but preferably bore into the calyx of flowers and eat out the heart. When nearly full grown, they are accompanied by ants, which tend them carefully and caress them with their antennæ to induce them to emit from their abdominal glands the honeyed secretions thence exuded, and which the ants lap up. The chrysalids are plump, oval, brown bodies, the abdomen considerably larger than the fore part of the body; they live in this state for only ten or eleven days, but a large proportion of the first brood, and all of the second, only disclose their inmates the next season, winter in this species being passed in the chrysalis stage.

PIERIS RAPÆ — THE CABBAGE BUTTERFLY

Just before the outbreak of our civil war, there was accidentally introduced into this country, doubtless by the passenger steamships crossing the ocean, a white butterfly known all over Europe as feeding upon cabbages and turnips. It first appeared at Quebec about 1860, and was subsequently again and independently introduced at New York in 1868. From the former point it at first spread slowly; for three years later it was not known at any point more than thirty miles from Quebec. After this, its distribution was more rapid, and, what is curious, it spread more quickly to the eastward, toward the ocean, than to the west, or even to the south; for it reached St. John, N. B., by 1866, and Halifax, N. S., by 1867, and was then known in New England only at the extreme north, and had spread no farther west than Montreal. It was not until 1871 that it covered the whole of New England.

Meanwhile, as we have said, it was independently introduced at New York in 1868, and in the following year was to be found everywhere ten or fifteen miles about. In 1870 it spread more rapidly in every direction, covering a corner of Connecticut, the lower Hudson, and the whole of New Jersey.

In 1871 the two invading hordes joined forces, and now covered the whole of the eastern United States and Canada east of a line drawn from eastern Lake Ontario to Fortress Monroe, or nearly all of New York, half of Pennsylvania and Maryland, eastern Virginia, as well as all of Delaware, New Jersey, and the New England States. From this time on, its march was rapid, and was aided by advance colonies started by independent accidental movements westward and southward along the great routes of travel. Thus it was introduced at Charleston, S. C. (probably by the coasting trade), in 1873, at least six years earlier than would have resulted from the southern movement by land; in 1874 at Appalachicola, Fla., still more prematurely; at Indianapolis, Ind., Chicago, Ill., and at Omaha, Neb., from one to three years earlier than in the surrounding regions. In 1878 the northern, southern, and independent western hordes (excepting that at Omaha, not then established) met, and the great migratory wave swept into the very heart of the Mississippi valley, crossing the river into Iowa and Missouri. By 1881, or at most by 1883, or in less than a quarter of a century since a pair or two were introduced at Quebec, it covered the whole face of eastern America east of the Great

Plains, from the Gulf coast to Hudson Bay, with the single exception of the greater part of the Florida peninsula. A year or two later it passed the Rocky Mountains, and is now virtually in possession of the whole country.

One principal cause of its rapid spread is the same as that which gives weeds of European origin so quick and wide a dispersal when brought into this country: in their native land they have been long under special checks, which are not found in what is to them a new country, and the "balance of nature" has yet to be restored after the disturbance they create. Another is the nature of the food-plants on which they depend for their maintenance, — plants which are everywhere cultivated in great numbers for their use as food for man and other higher animals.

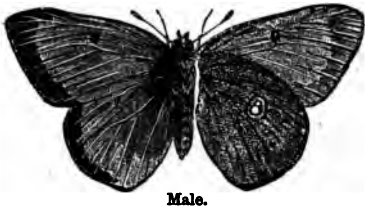
Yet we have other butterflies of our own, very closely allied to this, which feed upon, and are destructive to, the same plants, — cabbages and other cruciferous plants. Since the introduction of *Pieris rapæ*, however, these have become relatively innoxious, so vastly have they been outdone by the imported butterfly. Whether this will remain the case permanently is perhaps open to question; for when the "balance of nature" is restored, as we already see is becoming the case, by the relative increase of creatures which prey and fatten on our foreign invader, all may be found to share equally the detestation of the market-gardener. But in New England it has practically exterminated our other cruciferous-feeding species, *Pieris oleracea*, apparently by being a little earlier than it in its appearance, and so securing the most advantageous feeding grounds, and by breeding more rapidly. *Pieris oleracea*, which I have formerly seen whiten, as it were, the lawns about Boston, has not now been seen in the vicinity for many years, and appears to hold tenure only in some mountain fastnesses, and to depend probably, in great measure, upon wild Cruciferæ for its maintenance.

This imported Cabbage Butterfly has an expanse of about two inches; is of a dull white color above, with the extreme tip blackish, a round black spot just beyond the middle of the fore wings, and another at the front edge of the hind wings: the female has also a second spot on the fore wings below the first; beneath, the wings are washed with yellow and more or less flecked, especially on the hind wings, with griseous, and the markings of the upper surface are repeated in part.

In Europe the butterfly is reputed to be everywhere, except possibly in the Mediterranean region, double-brooded. With us, however, it is double-brooded only in the very northernmost part of its range; triple-brooded farther south, as in New England; and multiple-brooded still farther south. In New England, as about Boston, it appears fresh from the chrysalis shortly after the middle of April, a second brood about the last week in June, and the third in the latter half of August.

The eggs are elegant objects, Florence-flaskshaped, pale yellow, with about a dozen vertical ribs and numerous cross-riblets, and are laid erect upon the under surface of cabbage leaves, often many on a leaf, but not in contiguity; they hatch in about a week. The caterpillars are nearly uniform green, with faint yellow back and side bands, pilose and of uniform size, growing to the length of nearly an inch. Among the hairs upon the surface of the body are some mounted on more prominent papillæ; under the microscope, these may be seen to be hollow tubes, through which a fluid is emitted at the trumpet-shaped tip, to support which the edge of the latter is furnished with a fringe of a few excessively fine hairs, which enables a globule many times larger than the tip to be supported by it. The purpose of this is unknown, but may be for a defensive object. They feed upon a variety of cruciferous plants, but chiefly affect cabbages, into the heart of which they bore, filling the passages behind them with their excrement; they are very voracious creatures (whence Hübner named the group to which they belong Voracia), and gorge themselves till they seem near bursting. The chrysalids are green or yellow flecked with black and somewhat angular, having the sides of the body ridged, and on the abdomen and midthorax raised to a point, while the head is prolonged in front into a short, blunt, and upcurved tubercle. The winter is passed in this stage, but the summer chrysalids hatch in ten or twelve days.

The spring brood of butterflies differs from the succeeding in the heavier markings and more grimy under surface. A canary-yellow variety was occasionally seen when the butterfly was quite new to the region in which it appeared, but has latterly been very rarely noticed; it, too, showed similar dimorphism. The butterflies have a rather feeble flight, and one may follow the tremulous motion of the wings with the eye; they rarely rise above the ground to a man's height. Like most butterflies, they are fond of flowers, and have been thought to show a special predilection for those of their own color.



Male.

EURYMUS PHILODICE — THE CLOUDED SULPHUR

Zigzagging hurriedly over the fields and meadows almost every bright day from early spring till late in the autumn, this yellow butterfly, commonest among our northern species, is surely known by sight to every country dweller or visitor.

As with many of our earliest butterflies, its first appearance in the spring depends a good deal upon the season. The first brood — for there are several, and this is the least numerous — appears in the latitude of Boston on warm, sunny hillsides somewhere between April 25 and May 15, usually perhaps about the beginning of the second week of May. Along the southern coast of New England it is several days, perhaps a week, earlier, while farther north it is of course later. It is four or five days after its first appearance before it becomes at all common, and not for a week or ten days that any females can be found, all the earliest butterflies being males. About Boston it is most abundant at the end of May, and thereafter specimens caught on the wing are always worn; these fly in diminishing numbers through most of the month, though they are scarce in the latter half. The appearance of the second brood is varied, like the first, according to the latitude; around Boston it usually appears during the first week of July; in the White Mountain region not until late in July. It becomes abundant in about ten days, and continues so until the third brood appears, which is indicated by a great increase of fresh butterflies among those that are rubbed and worn; this takes place about the middle of August or a little later, and the butterfly remains on the wing until the frosts destroy it. One autumn it was seen after the middle of November. Thus, with a brief intermission of about a fortnight, when few individuals are seen (the latter part of June about Boston), this butterfly is common from before the middle of May to the early days of October.

Female.

It flies with considerable rapidity, though not so swiftly as some other species of the genus, in an irregular, constantly changing course, and with a hurried movement of the wings, about one or two feet only above the herbage. If a cloud obscure the sun, a field which appeared alive with them a moment before will quickly show scarcely a sign; the greater part will sink at once down into the herbage to await the reappearance of the sun.

When mates meet, they often flutter together higher and higher, always in an inclined direction, the male just above or in advance of his mate; while she flies rather steadily higher and higher, he dances in front of her, until suddenly, when very high in air, he darts toward the earth, and leaves her to fly calmly down again at her leisure.

This is a butterfly of the open fields and meadows. But, besides being fond of the flowers which grow there, it is very partial to moisture on the ground. The meadow-bordered highways after a rain are sometimes a wonderful sight on account of the myriads of this butterfly that may congregate about a puddle or a damp rut, coloring the ground as they sit crowded side by side with erect wings, so closely as nearly to touch. Thousands may sometimes thus congregate in a few square rods, and their nearly simultaneous rising, as one passes by, and their hurried settling again to their tame feast, are sights to be remembered.

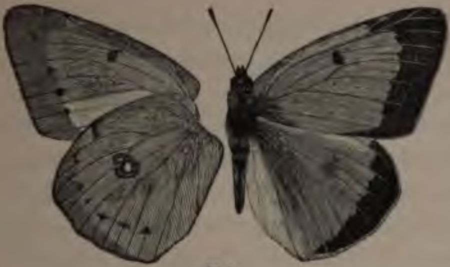
"At noon the roads all flutter
With yellow butterflies."

The wings are yellow both above and beneath, but below are deeper yellow, and often dusted with scattered darker scales, especially on the hind wings, which are marked in the centre with a reddish round spot having a silver pupil; above, the wings, and especially the fore wings, are rather broadly margined with blackish brown, but with a marked distinction between the sexes, in that the inner margin of the dark border is sharply defined in the male, vague and broken in the female.

Differences of color and of color pattern between the sexes are very common among butterflies, so that one may recognize the sex at a mere glance in a large number of cases. It is especially common in the group to which this butterfly belongs, and to the Blues and Coppers, and, while not often elsewhere so conspicuous as here, can be discovered almost everywhere. Whether meant as aids in recognizing one another or not, it would be hard to say, considering how often mistakes appear to arise among butterflies.

In the present case, however, there is an additional difference which is not constant, but occasional, and appears to grow more common as the season advances; for some females, besides differing in the regulation method from their mates, differ further in the general ground coloring of the wings, which become decidedly pallid both above and below. In other species of the genus, — species which occur in the high north, — all the females are thus pallid.

As caterpillars, these insects feed upon clover, and, to a less extent, on other leguminous plants. The eggs are laid singly — the operation requires but a few seconds — on the upper side of clover leaves near their middle, and they hatch in four or five days. They are very pretty, spindle-shaped bodies, perched on end, with numerous vertical and transverse cross-lines; they change color many times during growth, — yellowish-green, different shades of salmon color, and plumbeous. The caterpillar, on hatching, eats a part of its egg-shell only, and then bites a hole through the leaf and feeds on the edges of the hole; when the meal is over, it retires to the midrib of the leaf, which it so closely resembles in color that it is difficult to detect; when larger, and the stripped midrib will no longer sustain it, it rests on the stalk, and, being now also green throughout, except for a stripe of rosy color touched with velvety black along the sides, it is still very inconspicuous. It passes the winter in this stage, in all probability. The chrysalis is also green, pointed at each end, laterally somewhat compressed and somewhat fusiform, the few prominences compressed. It hangs in this state for about ten days.



Male.

EURYMUS EURYTHEME—THE ORANGE SULPHUR

THE Mississippi valley is the principal home of this butterfly, which differs mainly or most conspicuously from the species just considered in that the ground color of the wings is more or less orange in color. It closely resembles that species in all stages, and has a similar but more complicated life history, due to its greater range, and a polymorphism which is hardly exceeded by that of any other of our butterflies.

Among the mountains of northern Colorado the butterfly is digoneutic, flying in June, and again in July and August, and probably the species is here preserved by the survival of some of the latest butterflies through the winter. In Nebraska and Illinois it is trigoneutic, and both caterpillars and butterflies hibernate. In the lowlands of California it is either triple or quadruple brooded; and the butterflies, and probably caterpillars also, hibernate, while the upland races are only digoneutic, and considerable mixture is the result. In Texas it flies from November on, but totally disappears in June, and is not seen again until November, and in this short season there are no less than four broods. So, too, the clover that nourishes the caterpillar dies down to the ground before the last butterflies of June disappear, and only springs up again after the October showers; probably the hiatus is bridged over by the caterpillar.

It would seem that in similar localities the seasons of this butterfly and the last almost exactly correspond, or it may be the present species is a trifle later. In general it would appear that the egg state varies from four to nine days; the caterpillar may grow to maturity in a fortnight, or, not including those that hibernate, may have its stages so prolonged in the latter part of the season as to extend to four or five weeks, and the chrysalis hangs from nine to fifteen days.

The different forms of this species, assumed in different localities and at different seasons of the year, are so varied that they have been four or five times described as distinct species. Inasmuch, also, as the insect extends over a vast reach of country both latitudinally and longitudinally, its life history is modified, as we have seen, to a considerable extent, and a commingling of forms ensues which is often very puzzling to understand. Moreover, in the north the direct sequence of activities is interfered with by the winter; in the extreme south, on the other hand, by the summer, with its blazing sun, which dries up the food-plant so completely that, were it not for the lethargic powers of the caterpillar, the species must here become extinct.

It is difficult to present a clear picture of so complicated a life history and a polymorphism combined. In general it may be stated that there are three principal types, differing according to the amount and depth of the orange tint of the wings, the least orange being *ariadne*, the yellow-orange *keewaydin*, and the deep orange *amphidusa*, the two last at least having also a pallid female existing side by side with a female of the same tint as the male.

Female.

Now in northern Texas the cycle of changes begins with the appearance of fresh butterflies in November. During the warm days of winter, fresh examples are frequently found, and it flies uninterruptedly until the end of June, being most common in March and becoming more rare in May. The earliest butterflies up to the end of February belong to the form *ariadne ;* the new brood which appears in March is made up of *keewaydin ;* while those coming subsequent to this belong to *amphidusa*, and there are two broods of this form.

In the Rocky Mountains the earliest brood of the season consists of the form *eriphyle*, which, on higher elevations at least, altogether replaces the very similar form *ariadne* of the south. This is followed in June by a more abundant brood, and in July and August by another brood; these two broods are restricted, according to Edwards (who has paid close attention to this butterfly), to "*keewaydin*, and intergrade up to the paler variety of *eurytheme*, but a few individuals are taken which show a tendency to vary in the direction of *ariadne*." Combined with these, however, toward the cold season, are a certain percentage of *eriphyle*, a form which in the north would appear to be found at the two extremes of the cold season, while the more brilliantly colored forms belong to the hotter part of the year. There is, moreover, a difference between the autumn and spring forms of *eriphyle*, which thus may be regarded as itself seasonably dimorphic; the spring males being chrome yellow over both wings with a very uniform shade, while the October males are of a pale color, and the hind wings densely dusted with gray.

In Illinois and Nebraska the species is trigoneutic; but, though many of the early brood approach *ariadne* rather than *keewaydin*, the typical *ariadne* is not found, but only *keewaydin* and *amphidusa*.

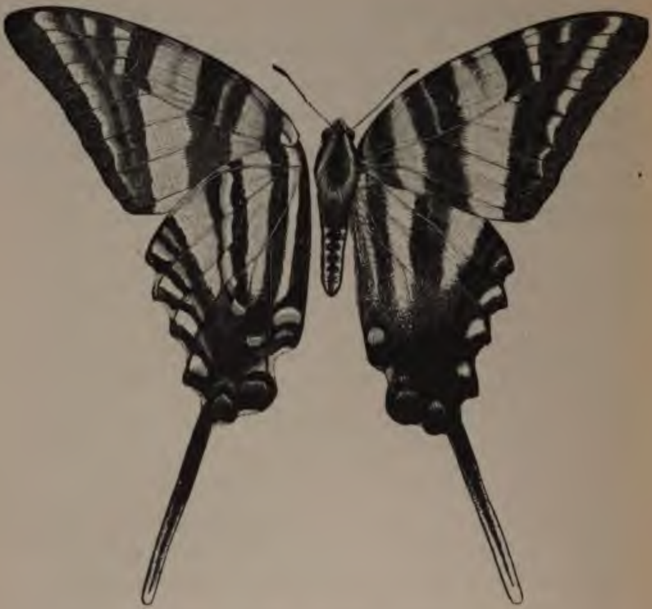
On the Pacific coast the admixture of forms is probably greater than anywhere else; for in the lowlands the southern yellow form extends as far north as Vancouver Island, while on the higher ground the northern yellow form, *eriphyle*, penetrates as far south as San Bernardino. In the lowlands the earliest brood, which flies in February and March, is *ariadne;* the second brood, *keewaydin*, flies in April, and continues on the wing with *amphidusa* the remainder of the season. *Eriphyle* appears in July, and is abundant in August and September; and *ariadne* again forms, in certain localities at least, a part of every brood.

To sum up, then, we may say that the polymorphism of this species exhibits itself in seasonal distinctions in all the broods, excepting the successive broods of the warmer part of the year in the more southern regions: the first brood showing so little orange upon the wings as closely to resemble the allied species, *Eurymus philodice*, and itself presenting marked differences in the northern and southern extremities of its range; the second brood of a pale orange, intensified in the disk of the wings; and the third and later broods, when there are any, of deep orange. Further, that in some parts of its range these distinctions are well marked, while in others the type characteristic of the earlier broods may reappear in any of the subsequent ones, and especially toward the close of the year, with the advent of the cold season, the spring type may reappear in considerable force. Finally, that in mountainous regions or their near vicinity there is an excessive intergradation of forms, probably due to the intermingling of those which have been born at higher and lower levels.

If in all this we keep in mind the dimorphism of the females of the later broods, we find a picture of diversity in unity uncommonly complex.

The habits and flight of this butterfly are very similar to those of its congener, *E. philodice*, but if anything its flight is more rapid. Whether or not the more brilliantly colored summer forms show a preference for flowers of an orange color has never been observed, as the yellow *philodice* is said to prefer yellow flowers. It has often been remarked that white butterflies alight by preference upon white flowers and yellow upon yellow. Direct observations (though none that have been systematically pursued) have shown that this vague opinion has some basis in fact, and several instances which show this, but at the same time show a lack of power of perception of form, have been published. Christy observed in Manitoba a yellow butterfly in search of flowers settling "momentarily, and exactly as if it had mistaken it for a yellow flower, on a twig of Betula bearing withered leaves of a light yellow color." Müller records seeing one of the European Bluets fly toward a very small bit of pale blue paper lying upon the grass, and stop within an inch or two of it as if to settle, doubtless mistaking it for one of its own kind. Plateau has observed the European *Aglais urticæ* fly rapidly toward a cluster of artificial flowers, and a white butterfly toward a white calla which could offer it no sweets.

That butterflies have some perception of color in mass is unquestionable; but if they do naturally prefer flowers resembling their own color, it must be regarded as due to natural selection, since, from their lessened conspicuousness when alighted on them, they would be to a certain degree protected by such a propensity; but the fact itself needs experimental proof.



IPHICLIDES AJAX — THE ZEBRA SWALLOWTAIL

THE Zebra Swallowtail, one of our most elegant butterflies, is found throughout our southern States east of the Mississippi in great numbers. The wings are black, transversely marked with broad and narrow whitish stripes, partly common to both wings, narrowing from above downward, and with a large blood-red spot on the inner margin of the hind wings, generally accompanied within by another; the hind wings bear very long tails. The under side is similar, but has more varied and brilliant markings on the hind wings.

Science is deeply indebted to Mr. W. H. Edwards for the thorough manner in which he has worked out the history of this butterfly by careful studies in the field and innumerable experiments. This writer has not only indisputably established the identity of two forms previously described as distinct species (though often presumed to be identical), but has proved the existence of a third permanent form, and has admirably traced the relations of each form to the others. The account here given is based almost entirely on his observations.

No histories of butterflies are of more interest than those of polymorphic species, whether considered in themselves alone, or in the light they are destined to throw upon the origin of species and races, problems which demand profound thought and conscientious investigation; and since this species is polymorphic in a larger sense than most American butterflies, our interest is enhanced.

The butterfly appears under three different forms, known as *marcellus*, *telamonides*, and *ajax*, — the polymorphism affecting both sexes equally. These forms produce one another in a complicated manner, but in general the imago exhibits what has been termed seasonal polymorphism; that is, a series of individuals adhering, in all their variations, to several distinct types, each type appearing on the wing at a different season of the year from the others: thus *marcellus* is the early spring type, *telamonides* the late spring, and *ajax* the summer and autumn type. Nearly all the butterflies which, in West Virginia, emerge from the chrysalis before the middle of April, are *marcellus;* between that and the end of May, *telamonides;* thereafter, *ajax.* The first two, however, do not appear properly to represent distinct broods, which is one of the most extraordinary features in the history of the insect, — paralleled by what we have seen of *Cyaniris pseudargiolus;* for *telamonides*, judging by recorded observations, is not the direct conseasonal produce of *marcellus*, but both are solely made up of butterflies which have wintered as chrysalids, those which disclose their inmates earliest producing *marcellus*, the others *telamonides;* while all butterflies produced from eggs of the same season — and there are several successive broods — belong to *ajax.* Thus, besides the true seasonal dimorphism which distinguishes the butterflies produced from eggs of the same season from those derived from eggs of the previous season, we have a sort of secondary seasonal dimorphism, separating the earlier from the later produce of wintering chrysalids.

Experiment has also proved that a portion of every brood of chrysalids, instead of disclosing the imago at the end of the ordinary time, retain it, occasionally until the appearance of a subsequent brood the same season, but usually until the next spring. The spring brood (*marcellus-telamonides*) is therefore by no means wholly produced from chrysalids of the final brood of *ajax*, but in considerable measure from those of all the earlier broods, even including the earliest *marcellus*. The proportion of chrysalids which continue until the next spring increases, as a rule, as the season advances; for of those produced from eggs laid in April more than ten per cent. pass over, those from eggs laid between May 1 and 25 about thirty-five per cent., from then until the end of June from fifty to sixty per cent., and from those laid in July about seventy per cent. *Marcellus* and *telamonides*, then, produce *ajax* the same season, or either *marcellus* or *telamonides* in the spring; *ajax* produces itself the same season, or one of the others in the spring; but neither *marcellus* nor *telamonides* is produced the same season by any of the forms. The few known exceptions to this but prove the rule.

The insect winters as a chrysalis. The earliest form, *marcellus*, appears in West Virginia with the peach blossoms about the 15th to the 20th of March. The males appear a few days earlier than the females, and both are found in great numbers on the blossoms of the peach, and later on those of the apple and wild plum. The caterpillars feed on the papaw, and as this is late in putting forth leaves, the butterflies are out two or three weeks before the young shoots of the papaw are visible; but no sooner do these appear than the females hasten to deposit their eggs. This is early in April, and they continue to lay throughout most of April and May; the eggs hatch in seven or eight days, and the caterpillars take three weeks or more to attain their growth.

Telamonides, the later variety of the same brood, begins to fly some weeks after *marcellus*, and both forms are for a time common. The female now lays eggs soon after hatching, and mating takes place while the females have their wings still limp from fresh eclosion. Eggs are found laid before the middle of May, and hatch in four or five days, while the caterpillars may mature in fifteen or eighteen days. *Marcellus* disappears about the first of June, and *telamonides* before the end of the month.

About the first of June *ajax* appears, and is shortly out in great numbers, continuing abundant till the end of October. The broods overlap so as to be distinguished with difficulty, but there appear to be at least three of them, the second appearing early in July, not only before the butterflies of the first brood of *ajax* have disappeared, but even before some of the butterflies of this first brood have appeared; after this there is evidently abundance of time for a third brood. The life of any individual, in Mr. Edwards's opinion, hardly exceeds two or three weeks; yet they continue to come from the chrysalis until October, when at last the frosts kill all in common, eggs, caterpillars, and butterflies, sparing only the chrysalids to continue the breed the next season.

The different forms of this butterfly are distinguished not only by their coloration and markings, but also by the clothing of the head, the form of the wings, the length of the tails, and by the size, the butterflies growing larger as the season advances, at least until *ajax* appears.

Forms of seasonal dimorphism like the present have attracted the closest attention of naturalists, and an explanation has long been sought of the causes which have induced them. Numerous experiments have been made which have brought to light the great probability that in temperate regions the retardation of development through cold has had much to do with these changes. The argument in favor of this view is much strengthened when we remember that, although seasonal dimorphism appears between the earliest and later broods of the season without always affecting all the members of each, and although it appears to be wholly independent of whether the winter is passed in the imago, the chrysalis, or the caterpillar stage, it is nevertheless true that no case of any kind of dimorphism affecting alike both sexes has yet been noted in any single-brooded species.

There would seem, therefore, to be ground for believing that temperature has much or all to do with seasonal dimorphism; and the manufacture, so to speak (by the artificial application of cold), of the spring type from chrysalids, which should normally produce the summer type, lends strength to this supposition; and on this account some have chosen to denominate the resulting varieties as "temperature forms."

But the same phenomenon appears in the tropics, where there are no such extreme excesses of temperature. Several years ago a Calcutta naturalist, De Nicéville, sent for exhibition to the Entomological Society of London several series of Indian butterflies, which had been universally regarded as distinct species, though they closely resembled one another, excepting that the conspicuous ocellated spots of the under surface of the wings of certain kinds, known to fly only in the rainy season, were replaced in other kinds, which fly only in the dry season, by more uniform, paler, and leaf-like markings in which the ocelli are obsolete. He regarded these as probable instances of seasonal dimorphism, — a view since sustained by breeding, and now generally accepted for numerous tropical forms; but at the time his views were vigorously combated. These facts show that we cannot attribute seasonal dimorphism to any one cause, but that it may be induced in more than one manner.

The eggs of the Zebra Swallowtail are pea-green, oblate spheroidal in form, and about a millimetre in diameter; they are laid singly, usually upon the upper surface of a leaf. The caterpillars are also pea-green, with a naked body, largest a little way behind the head, with transverse markings, consisting of black dots and lines and slender yellow stripes, besides a yellow-edged, broad, velvety black stripe on the largest part of the body. From the osmateria or forked protrusile glands of the neck, thrust out only for defence, there is emitted a most vile stench. The chrysalids are of one of two colors, green or brown, about an inch long and of stout form, with low prominences; they have a truncate appearance in front. The butterflies fly rapidly, with much fluttering, near the ground.

THANAOS JUVENALIS — JUVENAL'S DUSKY-WING

THE insects so far treated represent all but one family of butterflies, a family differing more widely from the others than they among themselves, and more nearly allied to the moths. Many naturalists regard this family of butterflies, the Skippers, as they are called from their peculiar flight, as of equivalent value to all the others combined. In temperate regions, at least, these butterflies are sombre in hue and little variegated; and that is the case with our first example of the family, Juvenal's Dusky-wing, an insect with rather unattractive and certainly inconspicuous livery. It is dark brown above, the fore wings sprinkled with gray scales, and with a transverse series of small, dull vitreous spots in the outer half of the wing, set in an obscure, broken, blackish band; two similar vague bands cross the wings within this; the hind wings and under surface have scarcely any markings, though the spots are repeated. The antennæ are hooked or recurved at the tip, and the eyes are overhung with a curving pencil of bristles, both peculiarities of Skippers.

It is widely distributed over the United States east of the Great Plains, though lacking in the extreme north, at least in New England. It is double-brooded in the south, and probably also in the north, or perhaps both single and double brooded, for the records of a second generation in New England are exceedingly few. Here it winters as a full-fed caterpillar in its nest, and during the month of March, or at the beginning of April, changes to a chrysalis; in this condition it remains a full month, and then takes flight. We have many species of Thanaos, but this is the earliest of them, the male appearing about Boston the first days of May, or even the last days of April. The female generally follows the male in a little more than a week, and both continue to emerge from the chrysalis until after the middle of May, the female probably nearly until the end, and they continue to fly until somewhat past the middle of June. The eggs are laid between the middle of May and the middle of June, and a second brood of butterflies, much less numerous than the first, appears about the 20th of July and continues through most of August. It is highly probable, from the ordinarily slow growth and habits of the caterpillar, and from the scanty numbers of the second brood of butterflies, that most of the caterpillars of the first brood feed until autumn, becoming full grown with those of the second brood between the middle

of September and the middle of October, and, sealing up the openings to their nests, betake themselves to their winter's sleep.

The butterfly is most abundant in open oak thickets, or by roadsides near them, where it is fond of resting with fully expanded wings on the wet sands. One may sometimes take them on the flowers of everlasting, on dry hillsides in the neighborhood of oak woods. The eggs are subspherical, with broad base, and about sixteen vertical ribs highest above, and are pea-green, changing afterward to salmon red. They are laid singly on oak twigs, crowded up against a leaf-scar or the petiole of a leaf, and perhaps on the leaves themselves, and hatch in eight or nine days.

The caterpillars are plump, naked, fleshy worms, about an inch long, largest in the middle, and tapering toward both ends, whitish-green, with a large rounded head of a color varying from dirty greenish to fawn color, heavily marked laterally with orange. They feed principally upon oak, but also on some leguminous plants, and live within a retreat they construct for themselves from a leaf by folding it over upon itself. Usually the leaf is bent downward by the caterpillar, and the under surface of the leaf forms the interior walls of its abode; at other times the reverse is the case, the caterpillar living on the upper surface, and the nest is then easily discoverable from the contrast which the duller color of the reversed portion bears to the uncovered part of the upper surface; the edges of the leaf are fastened together at considerable intervals by long strands of golden-colored silk, very strongly attached at the extremities. The openings left at the side (for the edge of the reversed portion is not brought to the very surface of the leaf) are also often covered by a thin network of delicate, tissue-like silk of the same color.

It travels on the leaf some distance from its nest for food, even in its earliest stage. One hatched in confinement did not at first build any nest, but resided generally on the under surface of the leaf. I removed it to the upper surface of a fresh oak leaf. It traveled for an hour or two incessantly over to the under surface, and then back again, and finally took up its station on the upper surface, ate a slight cut (in preparation for a nest-flap) at the edge of the leaf, and during the succeeding night the parenchyma of the upper surface, at a little distance from it, returning after each to its station. But it is impatient of the artificial conditions of confinement, and this one died before moulting.

It ordinarily rests quietly by day, back downward, upon the ceiling of its nest, feeding or working only by night; when disturbed, it opens its jaws widely, and scrapes them against the roughnesses of the leaf rapidly and repeatedly. On leaving an old nest to construct a new one, when half grown, it invariably bites off the silken strands of its old abode, allowing the flap to swing partially back to its original position. About the middle of September, or later, the caterpillar stops feeding, and begins at once to close all the openings to its abode with a slight but very tough silken film; this occupies it for four or five nights; the whole cavity is also thinly lined with silk throughout. Should any accident happen to the fabric, the whole is at once repaired, but the silk is then of a white color. Within this it passes the winter, as already stated.

When, in the early spring, the insect feels the time for pupation approach, it gnaws a passage through the end of its nest and constructs another, — at least in confinement, probably also in nature, for it would hardly be possible for the butterfly to escape from such a retreat, were the change to chrysalis made therein before an opening outward had been made; perhaps, as the leaves of the oak fall at about this time, it makes its way to the surface of the ground, and there constructs a suitable cocoon. Specimens bred in confinement, finding nothing better than old oak leaves as dry as those they had left, managed from these poor materials to construct a case similar in general form to the one they had left, drawing together and bending the dry leaves into the semblance of a cocoon, very slenderly protected, held together by very few cords, and lined with a few glistening threads. Within this, two Y-shaped shrouds were affixed, into the middle of the smaller of which the tail was plunged, while the body rested upon the arms of the larger. The chrysalis is subcylindrical and plump, without prominences, looking much like the ordinary chrysalis of a moth, of a dusky green color, somewhat blotched.

THANAOS BRIZO — THE SLEEPY DUSKY-WING

THIS butterfly is readily distinguished from the next preceding, which it otherwise resembles, by its slightly lesser size, the absence of the vitreous spots on the fore wings, and the presence on the same wings of two distinct dark cross-bands, with jagged black edges. It is widely spread, being found from the Atlantic to the Pacific, and from Nova Scotia to Florida; nor is it rare, yet its history is but meagrely known. It is, however, certainly single-brooded in the north, and in New England appears on the wing very early in May, and in southern New England sometimes in April. It generally becomes abundant about Boston by May 10, and is so irregular that it continues to emerge from the chrysalis all through this month and even into June, but even worn specimens are rarely seen later than June. The eggs are probably laid between the middle of May and the middle of June, hatch in about nine days, and the caterpillar feeds all summer; at the approach of winter it closes its nest, changing to chrysalis only in spring, in which state it continues about three weeks. By the little that is known about the apparition of the butterfly in the southern States, it is probably double-brooded there, and in some intervening region probably partially double-brooded, like Juvenal's Dusky-wing in New England.

The eggs closely resemble those of the preceding species, with fifteen vertical ribs of uniform height. The caterpillar has a dark brown head, with an orange spot on each side at the base of the jaws, and a naked, plump, pale green body dotted by darker green, and with an indistinct pale stripe on the sides. It feeds upon oak and leguminous plants, and lives in a nest it constructs from a leaf, precisely as in the last species. The butterfly frequents moist, shady spots and forest openings, and is difficult to capture, flying swiftly with frequent, sudden movements from one side to the other, but always remaining about three feet above the ground. The female is very fond of violet and blueberry blossoms.

If one examines closely a male of this butterfly, or indeed that of any of the species of this and nearly allied genera, he will discover that the front margin of the fore wing has a flap, which is folded over so tightly upon the upper surface of the wing as to escape ordinary observation. This reversed flap is an extension of the wing membrane of such a breadth, narrowing at each extremity, as, when closed, to leave the apparent contour of the front margin almost precisely the same as in the female; while, if it were turned back on a continuous plane with the rest of the wing, the outline would be noticeably different. At the same time, the reversed portion of the flap is colored precisely like that of the rest of the upper surface in its neighborhood, even including a part of one of the dark cross-bands, instead of being colored like the under surface, to which it really belongs. It is thus rendered completely inconspicuous. As one occasionally captures a specimen with this fold opened widely, perhaps through the violent fluttering in capture, it would appear to be reversible at the insect's will, though no mechanism is apparent for the purpose, except that a vein is developed here which is not otherwise found in butterflies.

The appearance within, when the flap is lifted, is altogether different from the rest of the wing; for it appears to be filled with a white or amber-colored silken floss. Examined under the microscope, this resolves itself into modified scales of an astonishing variety and curious appearance: there are rod-like bristles of three or four shapes, each found in a separate part of the fold; twisted ribbons, and colorless, smooth-edged scales of varying sizes, but the longest of all are less than a fifth of a millimetre long. In other species other varieties occur, such as jointed bamboo-like but flexible rods, slender rods shaped like a shepherd's crook, minute scales like an apple seed, and scales broad at base and tapering to a long thread. Nothing of the sort occurs in any other part of the wings, nor on the female anywhere. They are scales belonging to the male sex, and so are termed androconia.

Scales peculiar to the male are found in many other butterflies on different parts of the wings, sometimes more or less exposed, at others in folds or pockets; and as they are sometimes odorous, they have then been called scent-scales. Perhaps the androconia of Thanaos, or some of them, may have odors for the butterflies, imperceptible to us. That we should not be able to perceive odors from scented objects of such excessive minuteness is certainly not improbable. In this case the purpose of their being inclosed in a tight box, open at the will of the butterfly, is to conserve the odor to such time as it may be usefully employed by the owner of the treasure. Here is an open field, at any rate, for investigation.

POLYGONIA INTERROGATIONIS — THE VIOLET-TIP

We have a number of species of the genus Polygonia (or Grapta, as it is sometimes called), a genus which may be distinguished almost at a glance by their greatly angulated wings, which appear as if eroded at the edges. All are tawny-colored above, heavily spotted, and, especially the hind wings, broadly bordered with black; the other dark markings of the fore wings consist mainly of two stout oblique bars depending from the costal margin, and, around the inner bar, of a series of five or six rounded spots arranged in a bent line. The species differ principally in the coloring and markings of the under surface of the hind wings, which in the present species are highly variegated with patches and transverse stripes of ferruginous brown and ochraceous in the male, nearly uniform reddish-brown in the female, both having in the centre a reversed silver semicolon. (Plate II., Fig. 2.) It is the largest species of the group.

It is found over the whole of the United States and southern Canada to the east of the Rocky Mountains, but is much less common in the north than in the south. It is to be looked for in glades and gardens, and by the roadside in the vicinity of woods. It is very fond of sucking the sap which flows from wounded trees, especially oaks, and almost always alights on their trunks head downward; it is also attracted by decaying fruit. It is very subject to fluctuations in abundance from year to year.

The eggs are of a bluish-green color, barrel-shaped, with about ten vertical ribs, and are usually laid on the under surface of leaves, occasionally on the upper surface, sometimes on the stem, tender terminal leaves being preferred; they are sometimes laid singly, sometimes in a curious depending column of eggs, one above another to the number of five or six or even more eggs; three or four appear to be the ordinary number. The eggs hatch in from three to eleven days, according to the season.

The caterpillars feed principally upon hop and elm, but also upon other urticaceous plants, and even rarely upon linden. They are beset with branching spines placed rather far apart in longitudinal rows, with a pair on the top of the head; the body is of a chestnut brown, flecked with light dots so distributed as to form faintly oblique longitudinal stripes on each segment. They are generally found in a loose company, especially when young, since they feed directly on the leaf on which they are born; but they are not strictly gregarious, for those on the same leaf keep apart from one another, and as they grow older they scatter more and more. The caterpillar has a curious habit of resting after a meal with the head turned sharply backward on one side and a little tilted, so that one of the head-spines points vertically upward.

The chrysalis is of a dead-leaf color, very angular, with many spines in rows, those in the middle of the body nacreous, and the prominence in the middle of the thorax like an exaggerated Roman nose. It is suspended to a leaf, stem, or twig of the plant on which the caterpillar has fed, or upon some paling or substantial foothold in the vicinity, as the trellis on which a hop-vine has grown. The chrysalis ordinarily hangs for from seven to eleven days, but its duration may be much more extended, even to as many as twenty-six days.

In the north this insect is double-brooded, the butterfly hibernating and appearing again early in May. In the region about Boston it disappears by the middle of June or earlier, having laid its eggs late in May and early in June. These hatch in from four to ten or eleven days. The caterpillars attain their growth pretty rapidly, and, after passing generally from eleven to fourteen days in the chrysalis state, emerge as butterflies in July, some early specimens appearing during the last days of June. They continue on the wing until nearly the middle of August, laying their eggs in July and throughout August; and the butterflies of the second brood, which hibernate, appear toward the end of August, seldom earlier than the 24th, and continue to emerge from the chrysalis — which may hang longer than in June — until the middle of October. As one goes farther and farther south, there may be three, four, possibly five broods during the season, always ending with the overwintering butterfly.

This butterfly presents a most interesting case of dimorphism, one form, *fabricii*, having the base of the hind wings of the same color as the fore wings, the other, *umbrosa*, in which this part is obscured by dusky tints. The two forms, indeed, differ so greatly and so constantly from each other, not only in coloring, but in the form of the wings, that they were considered distinct species until they were bred from each other. In each form, moreover, the sexes differ considerably in the coloration of the under surface of the wings, so that the species includes four sets of individuals, which may be distinguished quite as readily as a great many acknowledged species of the best-studied faunas. Experiments and observation further show that the dimorphism is to a large extent seasonal. In the north, where the butterfly is double-brooded, the overwintering butterflies, which start the race in the spring, are, *almost* without exception, *fabricii;* their progeny is almost exclusively *umbrosa*, and these in turn produce *fabricii* again. In the south, where there are more broods, the overwintering butterflies again are *fabricii;* and from the experiments in rearing which Mr. Edwards has carried on in West Virginia, it would appear that their progeny, the first brood of the season, are entirely *umbrosa;* the second brood from eighty to ninety per cent. *umbrosa;* the third brood from fifty-five to sixty-eight per cent. *umbrosa;* the last brood no *umbrosa*, but all *fabricii.*

A similar dimorphism, affecting both the coloration and the contour of the wings, is found in some other species of this genus; but in none is it so marked as in this, and in some it is very slight. The step from such dimorphism as this insect presents to the formation of distinct species would seem to be very slight.

URANOTES MELINUS — THE GRAY HAIRSTREAK

THE delicate markings threading the under surface of the wings in the group to which the Gray Hairstreak (Plate II., Fig. 4) belongs have gained for them the name of Hairstreaks. The present is the commonest of the tribe in the United States, largely because, unlike most of them, it has more than one generation in a season. It is very widely spread, and, though rarely found in Canada, occurs in nearly every part of the United States except the most arid regions, and even here it is found in cultivated spots; in no place have I seen it in such numbers as by the shrubbery bordering a cultivated field in the heart of Utah. Southward it is found beyond the middle of the Floridan peninsula; and it is reported on good authority from Mexico, Central America, and even Venezuela. Few of our butterflies have a wider range.

It has an unequal pair of thread-like tails on each hind wing; the wings are bluish-black above, with a conspicuous orange lunule between the tails of the hind wings and lesser markings along its hind border; beneath, they are pearly gray, the outer half crossed by a pair of slender, more or less irregular black and white stripes, the outer-

PLATE II

1. Polites peckius

2. Polygonia interrogationis

3. Thecla calanus

4. Uranotes melinus

most more significant on the hind wings, which are much sprinkled with blue next the inner angle. The males of our butterflies of this tribe generally have a rounded discal spot of dead brown near the middle of the fore wings, filled with peculiar scales; but the Gray Hairstreak is a single exception to this rule, as it lacks this distinguishing sexual mark, — why, it would be hard to say.

It is a lively little creature, frisking excitedly about wherever it goes, with irregular movements often difficult to follow with the eye. It may be found about shrubbery and vines and sucking the flowers of Lespedeza; where common, it is often seen in little companies, dancing vigorously in and out of shrubbery or about coniferous trees, in the latter case at about five or six feet from the ground.

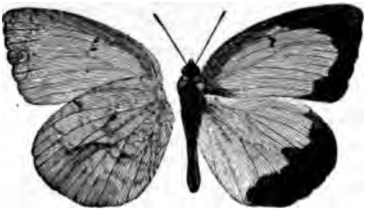
The eggs are laid singly, and are exquisite little bodies, shaped like a sea-urchin (Echinus), of a pea-green color, and very delicately reticulate with raised lines, which, where they meet, form little rounded knobs. Indeed, the eggs of all the members of the family to which this butterfly belongs are among the most elegant objects in nature.

Hop-vines nourish more than one butterfly, for here we have another, very different from the last in nearly every respect. The caterpillar is sometimes found on them in such numbers as to be a real injury, even in the northern parts of its range, so that farmers have sometimes abandoned attempts to raise hops. Our Gray Hairstreak, however, does not confine itself to hops, but feeds on an unusual variety of plants, such as Cratægus, Hypericum, and Cynoglossum, plants of widely different character. The caterpillars bore into the pods and seeds, and so destroy the fruit. They are very active when young, and capable of great elongation and contraction. They are slug-shaped, with a minute contractile head and reddish-brown, nearly naked body, without conspicuous markings. The chrysalis is brown, discolored and flecked with darker spots, with plump, rounded, oval abdomen, covered sparingly with short hairs.

It is the only one of our Hairstreaks which flies almost continuously from May to September, being apparently rather long-lived; as far as we can judge, it is double-brooded in the north, the insect wintering in the pupal state. It first appears in the early days of May, and may be seen throughout this month and part at least of June. A new brood makes its advent in July, or even by the very last of June, and flies not only through July, when the wings become rubbed, but also through August, and occasionally even until the middle of September; one capture has been made near Boston as late as October 10. In the extreme south, the butterfly is seen from the middle of March to the middle of November, and, unless the broods follow each other with such rapidity as to become entirely confounded, the records would seem to indicate three broods, appearing about the middle of March, the middle of June, and the middle of September, undoubtedly overlapping and growing successively more numerous in individuals.

Mention was made above of the lack in the Gray Hairstreak of the sexual mark of the male, common to all our Hairstreaks with this single exception. This is much as if, among our poultry, a breed should arise in which the cocks had no combs or spurs. Yet it is no uncommon phenomenon with butterflies. Thus the males of our numerous species of Argynnis have a row of long, erect bristles on one of the veins of the hind wings, which are not found in the species of the intimately allied genus Brenthis. Laertias is our only genus of Swallowtails in which there are androconia, concealed in a fold of the hind wings; while again, in Papilio, the neuration differs in the two sexes, and is alike in both sexes in all our other Swallowtails. So, too, some genera of our smaller Skippers have a conspicuous dash of heterogeneous scales, forming a stigma peculiar to the male sex, which is absent from allied genera. Such comparisons need not even be confined to distinct though allied genera; for some of our species of Eurymus have a patch of special scales at the base of the hind wings of the male, wanting in the female, and wanting also in both male and female of other species with difficulty separated from them; and a streak of androconia on the fore wings of the males of some species of the genus Œneis is wanting in males of other species so nearly allied that they are hardly otherwise to be distinguished.

When we look at the question from an evolutionary standpoint, it would seem necessary to conclude either that the relatively few examples we know where these sexual stigmata are wanting must have lost a feature which had formerly arisen for some advantageous purpose, or that the whole wonderfully varied phenomenon of the special development of sexual diversity must be of exceedingly late origin, *i. e.*, since the differentiation of the various species of one genus from a common ancestor, or, at most, since the development of the various genera of one tribe from a single source. Either horn of the dilemma lands us in an enigma.



Male.

XANTHIDIA NICIPPE — THE BLACK-BORDERED YELLOW

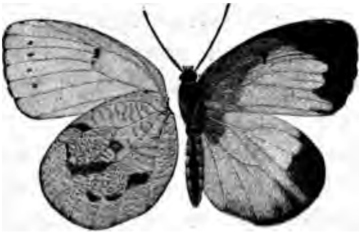
This is one of the commonest of butterflies in the southern States, where it is found on the wing through almost the entire season. It extends northward as far as New York and Wisconsin, but it is only in exceptional years that it is ever very common there, and in many years may be searched for in vain. In the south it extends across the continent, but further north is limited westwardly by the Rocky Mountains. It is also found in the Antilles, and in Mexico and Central America.

It is a butterfly of medium size, expanding about a couple of inches, of a bright orange above, though sometimes yellow rather than orange, and is bordered broadly with black, somewhat after the fashion of the species of Eurymus, but with less regularity. Beneath, it is bright yellow, the fore wings flushed with orange, and the hind wings marked with some short, transverse, ferruginous streaks, more conspicuous in the female than in the male. The sexes differ distinctly, though not greatly, in pattern, as shown by our figures.

The annual life-history of this common butterfly has never been properly worked out by any one, and the published memoranda are insufficient to treat of it with confidence. It undoubtedly hibernates as a butterfly, as specimens have repeatedly been known to emerge from the chrysalis at the very end of the season; in the extreme south they occasionally appear on the wing in midwinter, and in the spring but few are seen until the first, relatively late, fresh brood of the year appears. Moreover, Mr. Edwards, of West Virginia, placed in his cellar butterflies which had emerged late in October, and toward the end of January found them all alive, and in the same position in which they had been originally placed.

The butterflies remain on the wing in northern Florida until November, and appear again early in February, but in scanty numbers, only two or three specimens being seen any day until May, about the middle of which month fresh individuals appear, — the first brood of the season. By the end of the month they become abundant, and continue so throughout the rest of the season, there being a notable accession of fresh material about the second week in August. These two dates, then, the middle of May and the middle of August, doubtless mark the advent of fresh broods.

As in West Virginia, according to Edwards, the butterfly is present in several successive generations, and in overlapping broods, from early in May to the end of the season, and as in midsummer it takes less than a month for the passage of the preparatory stages, there is without doubt a brood between these two. There is also evidently a fresh brood in Florida in November, and the same thing appears to be true in Georgia, so that it appears most probable that there are at the least four regular broods. These evidently become confused toward the end of the season, for Edwards says that one day in September he cut a branch of wild senna on which were newly laid eggs, caterpillars in every stage of growth, and a butterfly just emerged, and still resting on the empty shell of its chrysalis.



Female.

The eggs, which are spindle-shaped, with about thirty vertical ribs, and of a yellowish-green color, are laid singly (but often many upon the same branch or even leaf) on the leaves of Cassia, and usually on the under side; they hatch in two or three days.

The caterpillars are green, slender, cylindrical worms, with a broad yellow band along the sides, slightly edged below with blue, and sprinkled with black dots, from each of which arises a short hair. They eat first the extreme leaflets of the plant, beginning at the tip of the leaf, and their only known food is Cassia, on three species of which it has been found. I have tried in vain to make it eat various other Leguminosæ.

The chrysalids are straight, green with white corrugations, with a conical frontal horn and very protuberant wing-cases, and about three quarters of an inch long. They hang from five to eight days.

The butterfly frequents open fields, and is often found in company with species of Eurymus and with Zerene, both on the wing and assembling and alighted about damp spots, sucking the moisture.

EVERES COMYNTAS — THE TAILED BLUE

THIS little butterfly (Plate I., Fig. 1) may be distinguished at once from all our other blue butterflies by the presence of a thread-like tail on the margin of the hind wings. On the upper surface the wings are violet in the male, but in the female dark brown, suffused with the male colors on the disk. Beneath, they are very pale brown, with faint marginal markings, and beyond the middle of the wing a more or less irregular series of small blackish spots or dashes.

It is one of the most widely distributed of our smaller butterflies. It has been found as far north as the Athabasca region, and I have myself taken it on the Saskatchewan. It occurs throughout nearly the whole of the United States, from the Atlantic to the Rocky Mountains, and in the north, even to the Pacific, while in the south, it not only reaches the Gulf of Mexico, but extends through Mexico into Central America.

It frequents the roadside or overgrown pasture tracks in the vicinity of woods, where it flies in a quick and nervous fashion, and is itself so small and delicate that one easily loses sight of it as it doubles in and out among the herbage, over the tops of which, unless very low, it is rarely seen.

Its flights are of short duration, and it frequently alights, after some seconds of uncertain quivering, on the heads or terminal leaves of plants and low shrubs and vines, especially of leguminous plants; and when alighted, with wings back to back, the hind wings are sometimes rubbed one over the other, while the fore wings remain motionless.

There are three broods of this butterfly each season. The first butterflies appear in New England from the 6th to the 10th of May, and the brood usually becomes abundant in five or six days, and continues plenty throughout the month; by the middle of June, sometimes by the end of the first week, it has disappeared. The eggs are doubtless laid toward the end of May and early in June; they hatch in a few days: the caterpillar grows rapidly, and the chrysalis continues but a short time, for the second brood usually makes its appearance between the 6th and 9th of July, occasionally as early as the 4th, and sometimes not until the 12th or 15th; the butterfly is plentiful in the latter half of the month, but afterwards becomes rare, although fresh specimens may often be seen the last of July and even very early in August, and a few individuals remain on the wing until the third generation makes its appearance. The eggs of this second brood are laid principally in the latter half of July, those I have secured being laid July 14 to 19 and 31: the caterpillars, maturing rapidly, attain their growth during the second week in August, and after nine to eleven days spent in chrysalis, the third generation appears about the 19th or 20th of the month, though sometimes as early as the 15th, and remains on the wing until at least the end of the third week of September; this brood must lay its eggs early in September, giving the caterpillar time to attain its full growth before winter, and to hibernate in this condition (as analogy renders probable), remaining unchanged until about a fortnight before the appearance of the butterfly in the spring.

Considering its wide distribution and the number of broods in the course of a season, it is surprising that so little variation has been noted in this butterfly. In western examples, however, the whole upper surface of the wings has a hoary aspect, and the dark spots of the under surface are remarkably faint. Southern examples, again, differ in the lesser depth of the purplish tint of the upper surface of the male, the narrower dark bordering, and in the purer and more uniform satin gray of the under surface of the wings. There appear to be no marked differences between the successive broods, but two different sets of individuals by size, which seem to mark especially the autumn brood. The female, however, is dimorphic in the south, where, in lesser numbers than the ordinary dark form, a female appears which is blue above, with broad black margins.

Late one July, while plucking a Desmodium flower in the Botanic Garden in Cambridge, I startled one of these butterflies from a neighboring flower. After a short flight, during which I remained motionless, it returned, alighted on the stalk I held in my hand, and under my very eyes laid an egg on one of the green buds beyond the blue flowers, tucking it into the crevice between two adjoining seed-vessels. Others, inclosed on Lespedeza, laid eggs high up on the stems, occasionally on the upper surfaces of the leaves, sometimes on the stalk itself, but generally either on one side of the base of the leaf-stalks, or tucked in between the flower-buds in some crevice, or in the axils of the leaves. Some inclosed on Desmodium laid eggs on the tender terminal leaves, or on the flowerets of the head. The eggs are pale green, smaller than the smallest pin-head, and are shaped for all the world like a tiny sea-urchin, dimpled all over with minute pits; they hatch in three or four days.

The caterpillars feed on various leguminous plants, such as Lespedeza, Phaseolus, Desmodium, and Galactia, living solitary lives; when young, they eat little furrows into the upper surface of the leaves; later, they feed rather on the calyces of the flowerets, curving themselves to the surface of the head or burrowing into it; before the heads form, they eat the immature flower-buds. The caterpillar is of a slug-like form, dark green, more or less pointed with pale dots, and with a black head; obscure dark oblique stripes are found on the sides of the body, and on the top of the seventh abdominal segment is a transverse slit, accompanied, on the succeeding segment, by a pair of evaginable fingers bearing a crown of filaments.

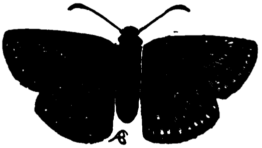
These two peculiar structures they share with many other caterpillars of this group of butterflies, and their use is in some instances known: for through the median slit a droplet of fluid is exuded, which is greedily lapped up by attendant ants; and the erection of the lateral glands appears to be a sort of signal to the ants that a droplet is forthcoming. This at least would seem to be the conclusion we should reach from the observations made on the living creatures, which are attended by ants in large numbers, which in great excitement attack any living thing that comes near their protégé. But not all caterpillars which have these organs are attended, or at least known to be attended, by such ants, and some caterpillars have one set of organs without the other, so that there is evidently much yet to learn regarding the matter. The caterpillars of the present butterfly present both sets of organs, but have never been seen to be accompanied by ants. The whole subject is one of great interest, and awaits fuller observation in the field.

A caterpillar which I had under observation took up position on the upper surface of a leaf for changing to chrysalis. The next day, noticing it appeared less easy to observe than the day before, I discovered that it had woven together two partially overhanging leaves with a web of silk, so as to conceal it from view from above. Two days later, when it had spun its girth, the overhanging leaves were found a little nearer, the tip of one being attached by a few very slight, long threads, at considerable distance from each other, to the leaf on which it itself rested. It was a neat and simple contrivance for concealment. The chrysalis is rather slender, well rounded, pale green, with a brownish-yellow abdomen, with a few dusky markings serially disposed.

THANAOS ICELUS — THE DREAMY DUSKY-WING

THE butterfly we now consider is the smallest of our many species of Thanaos, and is further distinguished from the others by the more conspicuous cinereous patch beyond the middle of the front margin of the fore wings, — more conspicuous mainly because the remainder of the dark grayish-brown wings is less variegated than usual, the other markings characteristic of the genus being more feebly developed. It also has a more northern distribution than any of its congeners, being found in Nova Scotia, Quebec, Ontario, north of Lake Superior, Lake Winnipeg, Alberta, and British Columbia, and even at Fort Simpson in the far north. Yet it also occurs far to the south, in West Virginia, North Carolina, and Georgia, and I have seen specimens from Mexico. In the heart of the continent, it has rarely been taken except far north or in elevated stations, — in Colorado and Arizona; but it is known to occur in all or nearly all the northern tier of States, as well as in Ohio, Indiana, and Illinois. It occurs throughout New England.

It is single-brooded, and hibernates as a full-fed caterpillar; it changes to chrysalis early in the spring, and remains from sixteen to twenty days in this state. The butterfly appears in southern New England about the middle of May, the earliest records being May 10 and 11 near Boston and on the island of Nantucket, tolerably common in each instance. Only males appear so early as this, and they are sometimes delayed until the 20th, when both sexes commonly occur. It becomes abundant in about ten days after its first apparition, and is found throughout June, and occasionally, in the latitude of Boston, until the end of the first week of July. In the White Mountains it never seems to appear before the last week in May, often not until the first of June; it may generally be taken, still fresh from the chrysalis, at the middle of June, and flies into July. In Colorado the season appears to be much the same as in the White Mountains; while at Nepigon, on the north shore of Lake Superior, I found the butterfly not uncommon and fairly fresh the first week in July. Eggs were also laid there at that time, hatching just before the middle of the month, or in about ten days. These are very pale green, of equal height and breadth, broadly rounded above, with from ten to fourteen stout, vertical ribs, highest above, and are laid singly on the upper surface of leaves.



The caterpillars, which have a light reddish-brown head, and plump, naked, pale green body dotted with white, so as to give it a gray-green appearance, and with a pallid lateral stripe, grow to a length of nearly three quarters of an inch, and feed upon aspen, willow, and witch-hazel, as well as on filbert and probably on willow, as I have found an egg, presumably of this species, on *Salix cordata*, at Nepigon. The caterpillar at once constructs and perpetually lives in a nest formed from a part of a leaf, as other species of the genus;[1] but the fastening threads are usually very long, so as to leave abundance of space for air, or, indeed, the entrance of nearly any enemy; when the time for a change of skin comes, these threads are all tightened, and the edge of the overhanging bit of leaf brought into close contact with the surface opposed to it, leaving at one end only just room enough to crawl out. When the change is effected and a new home is desired, these threads are all completely cut by the caterpillar before deserting the nest, which then springs half open, and these deserted nests are not unfrequently met with. During rest, the caterpillar remains in the nest on the overhanging roof, upside down. It eats only the leaf on which its nest is made, but feeds at some distance from the nest, and apparently only at night, as I have never found one outside its nest.

A caterpillar that had just made its third moult was placed upon a fresh leaf, and worked all night before it was housed again. But before it began work, it spent more than two hours partly in wandering over the leaf, and partly in remaining quiet as if lost in thought as to how the thing was to be done. Perhaps this was because it was at midday that it was disturbed, or its organs too tender to work so soon after moulting; for at the end of this long time, in beginning its task, it only ate a rounded hole at the edge of the leaf twice as big as its head, and then rested another two hours and a half, this time quietly, then spun a strand across from side to side of the slightly bellied leaf at a little more than its own distance from the edge, and again was quiet for another two hours, when it was left for the night. The next morning the cut had been deepened nearly to the midrib, another deep cut had been made to the midrib beyond its strand, and four or five more strands made from edge to edge, pulling the leaf over, rendering the first strand useless. It had accordingly been cut at one end, and dangled, crinkled up, from what was now the roof. Even now, however, eighteen hours after starting, the nest was by no means completed.

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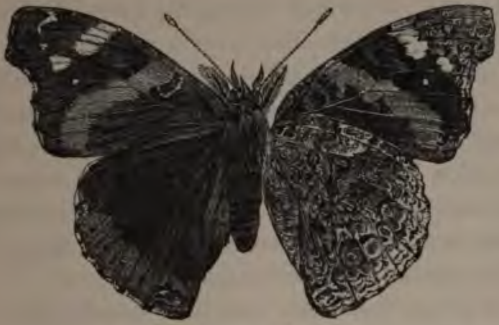
[1] See the story of *Thanaos juvenalis*, supra.

The caterpillar passes the winter in the larval stage within just such a nest as it has lived in all its summer life, but closed up and thoroughly lined inside with white silk. One found full-fed in July stopped feeding before the end of the month; it was then placed in a cool cellar, remained all winter in the same condition, and changed to chrysalis in the early spring without eating, and there was no evidence that it ever left its winter home; eight months of the year, therefore, were passed as a full-fed caterpillar, showing no signs of active life beyond closing with silk any openings which were made in the walls of its nest.

Open roads through woods in hilly regions, especially if these be damp from the vicinity of streams, will be found the favorite place of resort for this butterfly, which never swarms, but is often found singly in great numbers. When at rest on moist sands, a favorite spot, the wings are fully spread. When on the wing, the butterfly hugs the ground, and its flight is not so vigorous as that of its allies, nor does it struggle so violently when captured.

One examining with some care the male butterfly will observe that there is a fold of the membrane at the front edge of the fore wing above, which, when lifted, discloses what looks like silken floss of a whitish color; closely scrutinized with the microscope, this will be found to consist of a varied assortment of peculiar scales; first, seated on the marginal vein, a crowded, imbricated mass of pallid, long-oval scales, followed by an open field planted in a relatively sparse manner with little bilobed triangular scales; and this by a dense field of erect, slender, parallel-sided scales, slightly enlarged and trilobed apically, all the lobes rounded; these conceal between them triangularly lanceolate, slender, flagellate scales, only the flagella appearing above the mass; while large, ovate, generally asymmetrical cover scales complete the series.

This peculiar pocket of concealed and varied scales is a characteristic structure of the male in the whole group of larger Skippers to which this butterfly belongs, although the scales themselves differ in each species; and the great body, though not all, of the smaller Skippers are characterized, in the same sex, by a discal patch or streak of peculiar scales, in which not only are the scales different in each species, but the form of the patch or streak itself. Somewhat similar patches or pockets occur also in very many other butterflies, but in no group is it so common a phenomenon as among the Skippers.



VANESSA ATALANTA — THE RED ADMIRAL

THERE is not a little difference between the several species of hibernating butterflies as to the period when they leave their hiding-places and come, as it were, to life again. The Red Admiral is one of the last of such butterflies to make its appearance in spring, being seldom seen before the beginning of the second week in May about Boston; nevertheless, in more southern localities, for it is widely spread, it does not hibernate at all, but flies the winter through.

It is a very striking butterfly. The wings are almost black above, the hinder pair broadly bordered with brilliant red over most of their outer margin, forming a band which, when the wings are spread in the attitude natural to it, is continued across the middle of the fore wings in a bent curve; while midway between this and the extreme tip of the wings is a narrower, broken white band; beneath, the hind wings and the tip of the fore wings are infinitely diversified with a marbling of light and dark wavy markings having a general transverse direction. Its attitude, when the wings are closed for sleeping, is with the fore wings so closely concealed between the hind wings as to leave only this marbled surface visible, — a circumstance which undoubtedly often saves it from being seen and so captured by its enemies.

To judge from the fact that shortly after the earliest battered, or at least dull-colored hibernators take wing, and some time before any caterpillars of the species may be found, fresh-colored butterflies are seen in company with them, say by the last week of May, or at any rate by the first week in June, we judge that the winter is passed also in the chrysalis state, and that these fresh and bright butterflies are just disclosed; but I do not now recall that any one has carried the chrysalis through the winter to establish this point.

The eggs are delicate green in color, and barrel-shaped, with nine or ten thin, high, vertical ribs; they are laid singly on the upper side of leaves, generally near the middle, and never on the veins; they are not very firmly attached, but seem to cling by a corner, as it were, or any part that touches any portion of the leaf or hairs, and so to rest at any angle with the surface. Leaves about the middle of the upper half of the plant seem almost always chosen by the butterfly, and occasionally two or even three eggs may be found, separate, on a single leaf. They are laid throughout June, and hatch in five or six days.

The caterpillar is a spiny creature, growing to a length of an inch and a quarter, with a black head and variegated body. It feeds indiscriminately on every kind of nettle, and is also found on hop, false nettle, and (in the south) on Parietaria. After partially devouring the egg-shell from which it has bitten its way out, the caterpillar quits the leaf on which it was born, and hies him to one of the half-opened leaves at the very summit of the plant, where it lines the upper surface of the leaf with a silken web, so fastened at different points as to draw together the approximate outside edges, thus forming a canopy, within which it lives concealed, solitary, and indolent. Evidently the newly born caterpillar could not effect such an operation on any other than the more tender, newly opening leaves; and it therefore seems strange that the parent should choose for oviposition leaves farther down the stalk, the duration of the egg being so short, and the topmost leaves in a nettle patch far more accessible to the butterfly. Most of the feeding is done at night, when it eats the substance of which its nest is composed without disturbing the framework of the leaf. After moulting it quits this nest and takes possession of an expanded leaf, when it first gnaws nearly through the midrib at the very base of the leaf, and cuts also a hole next the rib in the base of the leaf itself, by which processes the leaf is made to droop, and then the opposite edges of the leaf are caught together by silk to form a canopy; often it cuts holes between the next pair of side veins, and then the lateral rib between the holes is weakened by gnawing, to enable the caterpillar more readily to pull the edges of the leaf together. In this abode it eats first the parenchyma of the leaf within the nest, but when it has grown a little, and ever after, it eats the edge of the leaf entirely through at the drooping extremity. After each moult it seeks a new leaf and constructs a canopy, and then proceeds in similar fashion gradually to eat itself out of house and home. As it grows older, the successive canopies are more securely made, the edges fitting more tightly; but they are always wide open at the drooping extremity, which forms the pasture ground, and within the last one the caterpillar not infrequently changes to chrysalis, quite out of sight except to one looking in from below; but it generally seeks some firmer attachment quite away from its feeding ground, and hangs for ten days.

The butterflies from this first brood of caterpillars appear during the first days of July, and continue to emerge from the chrysalis throughout the month. Eggs are laid at once, and another brood of caterpillars may be found from the middle, or a little before the middle, of July to the last of August. The butterflies appear the very last of August and early in September, and fly throughout this month and even later, though in gradually diminishing numbers; they are among the last of our hibernating butterflies to seek their winter quarters, and, as stated above, it is believed that some of the chrysalids of this autumn brood do not disclose the butterfly before the ensuing spring.

The longevity of the butterfly is so great that, apart from its hibernation, specimens may be found throughout the whole season, and in warm countries the whole year through. The hibernating butterflies pass the winter in crevices of rocks, in hollow trees, and under house roofs. The flight of this brilliant butterfly is vigorous, quick, and nervous. When resting on the ground after flight, it often alternately expands and closes its wings; when quiet on the ground, the wings are extended horizontally as if fully to display its brilliancy, but when alarmed, the wings are shut back to back with a sudden snap. The butterfly is never to be found except in sunny spots, and seems to enjoy cultivated surroundings, especially gardens, and in spring frequents lilac blossoms, in autumn, dahlias. It also sucks the juices of fruits, and may readily be caught about sliced apples drying in the sun.

It enjoys a wide geographical range, extending over nearly the whole of the continents of Europe and North America. In our country it is found as far north as Newfoundland and southern Labrador, Hudson Bay, and Vancouver Island. Southwardly, it is not only found everywhere in the United States, but in Bermuda, Cuba, Hayti, Mexico, and the highlands of Guatemala. It is probably found wherever nettles occur.

This is one of the butterflies which is very irregular as to its abundance in any one locality, probably due to the fact that it is more than ordinarily affected by the action of parasites, which attack it principally in the caterpillar stage. Many are already definitely known. There is one which must sting it before the caterpillar has finished its very first stage. Any one that will watch a newly hatched caterpillar will observe its excessive restlessness until its nest is made, and one finding such a nest may often discover only the larval skin with the silvery gray cocoon of its enemy beside it. Here one parasite is enough to finish its victim; far worse havoc is made at a later stage by another species of parasite of the same genus. It is often difficult to procure a single butterfly from a large number of larvæ taken in the open air; each is a peripatetic banqueting-hall crammed full of these parasitic enemies, which suddenly emerge together through the skin of their victim when full grown, and spin their pure white cocoons beside their now collapsed prey. There are at least three broods of this kind of parasite in a season.

To see the operation of this little parasite, I once placed some winged females two days old under a glass with caterpillars of this butterfly. The parasites were put in first, and the caterpillars introduced afterwards. There was no change in the action of the parasites at this time, no recognition of the presence of their victims, although both before and afterwards they were in constant motion, evidently in search of prey. In their blind wanderings, coming into contact with a bit of web made by one of the caterpillars in the angle of a nettle leaf, and vainly endeavoring to penetrate it, they at once went vigorously to work to bite their way through, as if confident that the object of their search was beyond. They did not seem to be aided at all by sight, for they frequently ran accidentally into the caterpillars when they were in their way, and turned aside as soon as their antennæ came into contact. The smaller caterpillars were not stung, but the larger ones were repeatedly pierced. On meeting these there was a momentary pause, then the parasite ran or jumped, as it were, upon the side of the caterpillar, flirted its wings in the air, stung it in an instant's time, and then ran off and about as before. It seemed to be indifferent as to whether the caterpillar was in motion or quiet. When the caterpillar felt the sting he started, and then walked quickly away. In five or ten minutes the parasites became perfectly quiescent, although they had stung the caterpillars but a few times. Perhaps they had exhausted their momentary supply of eggs.

Two other kinds of hymenopterous parasites belonging to different genera are known to attack these caterpillars; the coal-black chrysalids of one of them, to the number of twenty or more, are sometimes found standing erect on their hinder ends around the corpse they have destroyed, like black tombstones in a cemetery, a most melancholy spectacle on opening a nest to get the young caterpillar.

As if these were not enough, a dipterous foe ravages what the hymenopterous parasites have left. It stings the caterpillar, with the result that, either from the full-grown larva, or, and more commonly, from the chrysalis, a maggot, or sometimes a pair of them, emerges, which quickly changes to pupa on the ground, and in a fortnight turns to a fly resembling in general appearance the house fly.

I have entered here somewhat into detail regarding the parasites of this butterfly only to illustrate what perils all our butterflies, in greater or less degree, have to encounter. Even in the egg state they are not free from such attacks, little dots or specks of parasites attacking them in considerable numbers, "life living upon death."

HEODES HYPOPHLÆAS — THE AMERICAN COPPER

A HOT, fiery-looking creature is our next butterfly, its coppery wings gleaming in the sun. It "would be perhaps the most splendid butterfly we have," says one old writer, "if its size corresponded with its beauty. . . . The richness of the glowing flame-colored wings is worthy of admiration, and the under surface is very delicate; and I do not see that it is less beautiful because it is diminutive; though if it were as large as a Swallowtail or a Camberwell Beauty, it would strike the attention more readily."

It has a spread of wings of scarcely more than an inch, and the wings have no sharp angles. The upper surface, especially of the fore wings, is brilliant red, with a coppery lustre, spotted conspicuously with black; beneath, the fore wings are duller than above, and the hind wings are slate-gray, with dots of black and a thread of orange next the outer margin.

It is found throughout Canada and the northern United States, from the Atlantic to the Pacific. In the east it is found along the Alleghanies as far south as Georgia, and northward it extends to Nova Scotia, Cape Breton, and Hudson Bay. It is one of the commonest butterflies of New England. Even the lovers of nature, shut up within the walls of our large cities, can enjoy in any public park a sight of these ubiquitous flutterers, can watch them in their hymeneal dance, as they toss themselves up and down in contra-unison and then flutter away to repeat the sport in another spot.

The butterfly is double-brooded in the northern, triple-brooded in the southern parts of its range, the change occurring in the east at about the middle of New England, but with some variation. Throughout Maine, at least as far south as Brunswick, in northern New Hampshire and the higher parts of Berkshire County, Mass., it is double-brooded; it is triple-brooded throughout the rest of Massachusetts, even in elevated spots, as well as in southern New Hampshire and Vermont.

In the southern or triple-brooded districts the butterflies make their first appearance between May 10 and 23, according to the season. Dr. Harris raised one specimen from chrysalis on May 1, but this was probably under artificial conditions. He, however, reports one capture as early as March 15, and Dr. Packard another in Brunswick, Me., April 3, both of which seem to be altogether exceptional, and probably the result of unusually warm weather acting upon chrysalids in very favorable stations, untimely births which could come to no good end. The butterfly becomes common in about a week, and continues to fly until about the end of the third week of June. The eggs are laid during June and, in advanced seasons, during the latter part of May, and these hatch in from six to ten days, according to the weather. The caterpillars become full grown during the latter part of June and early in July, and after about ten days spent in chrysalis, evolve a new brood of butterflies. This first appears between July 5 and 10, becomes abundant by the 20th, and continues until after the middle of August, sometimes until almost the end of the month. The eggs are probably laid during the last week of July and the first half of August, as pairing is then common; the earliest caterpillars become full grown toward the middle of August, while the chrysalids continue for a longer period than in July, sometimes for nineteen days. The third generation of butterflies is much the most abundant, and appears in the latter part of August, generally by the 26th, but sometimes not until the early days of September; butterflies continue to emerge from the chrysalis until the middle of September, when the brood is most abundant, but it has generally entirely disappeared by the close of the month. The eggs of this brood are laid in September, are hatched in eight days, and the caterpillar probably changes to chrysalis before winter, though it is possible that the winter is passed as a full-grown caterpillar. The contrast between the numbers of the first and last brood of butterflies shows that in whatever stage winter is passed, many individuals succumb to its rigors.

Where the butterfly is double-brooded, the first generation does not make its appearance until June, usually between the 4th and the 10th, though in favorable seasons a few specimens may occasionally be seen late in May; it becomes common by the 20th, and lasts until nearly the middle of July. As far north as Quebec, however, it does not seem to appear before the last of June, and probably continues there throughout July. The second brood is first seen between the 6th and the 12th of August, and continues to emerge until the close of the month, and flies until the end of the third week of September.

The eggs are unique of their kind, flat, bowl-shaped, covered with large, shallow pits, with moderately heavy walls, and of a very delicate green color. When laying her eggs, the female flies to a plant of sorrel, remains nearly or quite still, often for two minutes or more, and then walks down the plant, moving this side and that in search of a suitable spot, until, finally, turning entirely around, and curving the abdomen downward, she deposits a single egg; this occupies about three seconds, and then she crawls back and at once takes flight. The eggs are usually laid near the base of the leaf on the rounded surface, but sometimes on the leaf itself, indifferently above or below, and occasionally on the stem. Many eggs may be laid upon a single plant, but I have never found more than one on a leaf in free nature. They lay readily in captivity over the plant.

The caterpillar is a slug-like looking creature, with diminutive head, and wholly green, except before its full growth, when it may be faintly roseate along the sides. It feeds upon sorrel, and, in escaping from the egg, eats only a small hole in the summit to crawl out from; usually it feeds upon the under surface of a leaf, and while very young, eats little holes of about its own size halfway through; afterwards it ploughs its way through the parenchyma of either surface, making straight or slightly curving grooves as wide as its own body and several times longer; when still older, it devours the leaf along the edge.

The chrysalids are brown, rounded, oblong bodies of an uninteresting appearance, covered, when closely examined with a lens, with mushroom-shaped hairs, profusely scattered over the surface, the disks colorless and delicately fringed. They are to be found attached by a median loop to the under surface of stones.

The butterfly is commonly found in dry, sandy, or gravelly, barren spots favorable to the growth of sorrel, and is particularly common by the side of paths in dry pastures or upland highways. It constantly invades the town, and seems to delight in finding the hottest place for its gambols. It is a fearless little brilliant, and pays slight heed to an approaching footstep. It is very pugnacious, indeed, attacking and pursuing larger butterflies and any passing object, even assaulting the monstrous Carolina locust in its short and heavy flight. The butterflies alight on stones or twigs, and sun themselves, or flit away over the clover heads; whenever they alight, even if on a twig, they at once turn around so as to bring their back to the sun, and open their wings at right angles. They never fly long distances, nor in ordinary flight rise more than a foot or two above the ground, but flutter rapidly from side to side with a peculiar motion; after each flutter the wings are apparently kept closed for an instant, for their under surface is then distinctly visible. When two of them meet, they circle rapidly and coquettishly about each other, always keeping near the ground.

It is curious to watch their proceedings in pairing time, for they remind one forcibly of the English sparrows. One may be seen perched on a leaf, its hind wings quite still and horizontal, while the front pair are slightly raised and in a constant flutter. Its follower will be close behind, apparently unconcerned, but as it walks after the leader, the latter walks off a little farther; the little play will proceed awhile, when the leader flies away, quickly followed by the other. Which sex takes the lead in this performance I have never determined.

In keeping with the activity of this butterfly is the fact that it is one of the first butterflies to appear after sunrise, and one of the latest to disappear at nightfall. It is on its unceasing rounds the livelong day. Toward night it seeks the grass, where, about halfway down a stalk, with head downward and closed wings, it goes to sleep. If then aroused and forced to fly, even though still broad daylight, it settles at once in a drowsy fashion.

Occasionally specimens are found in which the markings of the fore wings are essentially altered by the lateral extension of the large black spots which cross the outer portion of the wings, all the interspaces being shot with black. These are called examples of suffusion, a phenomenon which is occasionally found in some other of our butterflies, but is more common here than elsewhere. I have indeed seen above fifty examples in this species.

In general, the disguise is produced by the blending of certain colors, especially of black, white, or silvery tints, which are normally found at distinct parts of the wing; usually it occurs where there are two parallel or nearly parallel series of markings, following in general the same course as the outer margin of the wing. There may be, for example, two parallel series of white spots normally crossing the wing, one near the middle, the other next the border; under this disguise of suffusion, the whole intervening area, in the interspaces where these spots occur, is covered or shot with this color, generally more or less sprinkled with atoms of the normal ground, producing then an impure tint, and sometimes altogether obliterating any intervening markings of another character.

Although of our own butterflies this phenomenon is commonest, as stated, in the present species, it is in general more widely known among the Argynnids and Melitæids, groups which are characteristic of the temperate regions of the earth; and it is in entire keeping with this fact that examples of suffusion are almost exclusively confined to the temperate zone, rendering it probable that cool temperature is the efficient cause of its appearance. It is of relatively frequent occurrence also among the butterflies of the Swiss Alps, and in spring broods of our own butterflies. Besides which, in experiments where cold has been applied to chrysalids, such suffusions have been artificially produced.

ANOSIA PLEXIPPUS — THE MONARCH

THE Monarch, or Milkweed Butterfly, is one of our most interesting insects, about which a volume[1] (from which this account is condensed) has been written, but of which we have still much to learn. In the summer time it is found over almost the entire continent, certainly as far north as well into the Dominion of Canada; and yet it is probable, as we shall see, that it does not exist in the winter farther north than the Gulf States. It has extraordinary powers of flight, more so than any other known butterfly; and every autumn, when abundant (after first collecting in vast flocks or bevies of hundreds of thousands, changing the color of the trees or shrubs on which it alights for the night), migrates southward in streams, like our migrating birds.

It is a large butterfly, with an expanse of wings of about four inches. A deep orange-red forms the ground color; but there is a wide margin of black on both wings, more or less dotted with pure white, while the veins forming the framework of the wings are all traced in black, and across the somewhat falcate tip of the fore wings is a broad, oblique black band, almost or quite merging into the outer black border, while within this are found a couple of rows of more or less sordid white spots of a squarish form. The body is black, but the thorax is dotted with round white spots, and the abdomen is narrowly ringed with white.

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[1] S. H. Scudder: *The Life of a Butterfly.* New York: Henry Holt & Co. 1893. 16°.

The course of life of the Monarch is a simple one. Winter is passed in the perfect or imago state, but in what sort of places is not known; in the extreme south it remains on the wing, but that is not the case farther north, where the cold would make it impossible. In the proper range of the species, the warmth of the early spring lures the hibernating butterflies from any places of concealment they may have had, faded in color, but, their wings being tough, not so often ragged in attire. In West Virginia they may be seen on the blossoms of the wild plum the last of March, and on lilacs and other flowering shrubs in April. The tender leaves of the milkweed, on which the caterpillar feeds, are just appearing above the ground, and on these the females hasten to deposit their eggs; they are usually laid on the under surface of the terminal leaves while these are still vertical.

The eggs are exceedingly pretty objects, somewhat in the shape of a blunted sugar loaf, a little more than a millimetre — or less than a twentieth of an inch — high, amber green in color, the glistening surface broken up by about twenty-two slight, longitudinal ridges, and the interspaces traversed by straight and fine cross-lines, while the summit is crowned with a little rosette of cells of extreme delicacy. The egg hatches in four days or even slightly less, but is sometimes delayed so as not to hatch for five days or more.

Immediately it has escaped from the egg, the caterpillar completely devours the shell, as if to leave no manifest token to the wily and vigilant ichneumon fly that its former inhabitant was near at hand, and then attacks the leaf on which it was born, eating a slight hole often entirely through it, and when it has done feeding, retires to the concealed side of the leaf; if it be still erect, to the inner, that is, the upper side; if extended horizontally, to the lower surface. As soon as appetite returns, — and it is a voracious feeder, — it has its food ready at hand. So it eats and rests, and rests and eats, at night apparently quite as well as by day, except that it is more sluggish in cool weather, and nights are cool. In a day or two the caterpillar makes its first moult, but its habits remain much the same. Three other similar moults follow before the caterpillar has attained its growth, which may be acquired in eleven days from the egg, though it is usually longer than that, and in cool weather may be greatly extended.

The caterpillars are striking objects, — rounded, plump, naked, green worms, growing to the length of nearly two inches, with transverse bands of yellow and black. The body tapers a little in front, and the head is of much smaller diameter than the middle of the body, with the yellow face conspicuously marked with two parallel black arches. From the top of the second segment behind the head grows a pair of long and slender, flexible, black filaments, which have a twitching motion when the caterpillar is feeding or alarmed, and move alternately forward in marching; a similar but shorter and inactive pair of black filaments is found on the top of one of the terminal segments of the body.

These filaments are scarcely observable in the first stage of the caterpillar, which is then armed with several series of simple, short hairs, arising from papillæ, which are practically lost afterward, so that the clothing of the first and last stages is very different.

To seek a good place for the change to chrysalis, the caterpillar usually leaves the plant and seeks some such stable place as the under side of a fence rail or a jutting rock to suspend. It usually hangs for about twelve days, ranging in New England generally from nine to fifteen days, but in the south the period may be reduced to five, and one report gives two days! I have known it to be extended to three weeks. The chrysalis is a very striking object on account of its coloring. It hangs by a slender little peduncle of shining black, and is very compact and stout, with plump, rounded form, and only the slightest projections, all of which are rounded; the plumpness is in part due to the shortness of the abdomen, the joints of which, beyond the third, rapidly shorten and contract, leaving at the hinder edge of the latter a ridge which encircles the body (except the wings) at its stoutest part, and is made the more conspicuous by bearing little tubercles set in a belt of color, shining black in front, nacreous in the middle, and golden behind, while the entire body of the chrysalis is of an emerald green, except for a few gilt or black dots on other definitely scattered tubercles.

How often this cycle of changes may be repeated during the year is doubtful and certainly variable, the weather and latitude being undoubtedly important factors. Riley, making his observations in Missouri, considers that there are but two broods annually in that region. Edwards, in West Virginia, believes there may be four or five in his district, and one would hardly look for more in the one than in the other. It is true that the cycle may in a given case be reduced to as little as three weeks; but believing, as I do from observation, that the mother lays her eggs one by one over a considerable length of time, it seems to me most probable that north, say, of Washington there are at the most two broods a year.

The question is, however, more or less involved in that of the distribution of this insect; and here we touch upon a point of special interest, for but one other of our butterflies is so widespread. It is a distinctly American form, belonging properly to the tropics. It is found all over the West Indies as well as on the mainland, and extends beyond the tropics much farther in the north than in the south, for its southernmost known location in South America is the very northern border of Patagonia, in latitude 40°, while in North America it extends over nearly every part of the United States, no part of which lies within the tropics, and even over a large part of Canada, having been reported even from Hudson Bay and the Athabascan region, twenty degrees farther from the tropics than in South America.

Belonging as it does to a distinctively tropical group of butterflies, it appears here quite out of place. The semi-tropical character of the southern United States does not make its appearance there surprising; but farther north, beyond Philadelphia (which corresponds in latitude to its farthest in South America), it clearly appears like an interloper. Precisely here comes in the interesting feature in its distribution. We are accustomed to think of the butterflies we see as born and bred in the district where they are seen. Yet from abundant observation we know of massive movements of this butterfly southward in the autumn, and there seems to me nearly every reason to believe that its natural northern limits are not farther north (perhaps much farther south) than about 40° on the Atlantic border, and that the eggs, caterpillars, and chrysalids of the butterfly found much north of this are in all cases the production of immigrants from farther south, no perfect butterfly born at any considerable distance north of this assumed limit ever laying an egg the same season.

Indeed, it is probable — such is my belief in the vagrant habit of the butterfly — that a butterfly successfully hibernating farther south may fly to some distance still before depositing all her eggs; and the progeny from these, though born so far north, would again lay eggs. But by far the greater part of the eggs laid beyond the limit are laid by butterflies of the second generation, born farther south, and wandering northward in search of "fresh fields and pastures new;" and their progeny will not lay eggs the same season.

In New England, for instance, a hibernated butterfly of this species is an extraordinary rarity, and the first butterflies of the season are (with these rare exceptions) those which appear when the milkweed is already a foot or more above the ground, synchronous with or slightly later than the descendants of the hibernators farther south, fresh and bright butterflies, certainly born the same season. They are long-lived, laying but few eggs at a time, and probably not depositing all until several weeks after birth. The butterflies are seen on the wing the rest of the season: first the parents, next their children, the parents gradually dying out. There is no evidence whatever of two broods of caterpillars in New England; that is, that these children ever lay eggs the same season, so that it appears quite plain that in New England this butterfly passes but once through the entire cycle of its changes.

The fact that the butterfly has been seen on the shores of Hudson Bay and in the Athabascan region, beyond the limits of the growth of its proper food-plant, is another proof of its northward migration in the warm season. But of the return movement in the autumn there is plenty of evidence. Apparently, wherever it abounds in any part of the United States, certainly from Ontario to Florida, and from Maine to Iowa and Missouri, the butterfly shows a tendency about the first of

September to swarm in immense numbers, and at night to settle down upon trees and shrubs in such masses as to change the whole effect in color. This gathering of the clans is but the first step in the annual southward movement which has been observed in numerous places. I was myself fortunate enough to observe it in 1888. While sitting on the piazza of a house facing the seashore at Hampton, N. H., and only a stone's throw from the water, between nine and ten o'clock in the morning of September 2, a continuous stream of these butterflies passed before me toward the southwest, following the line of the seacoast, with the wind about northwest. There were never less than three or four directly in front of me, often a dozen or twenty. In the hour that I watched them, I calculated that at least fifteen hundred passed me, and without exception in the same direction.

As flocks have been seen in northern Florida, it seems highly probable that the southern movement may extend over the entire United States, and that the northern limit of the returning hibernators may be the limit within which the butterfly is double-brooded. As Riley, the first to suggest an annual migration of this butterfly, remarks: "There is a southward migration late in the growing season in congregated masses, and a northward dispersion early in the season through isolated individuals."

Another fact in support of this theory (for it is not yet proven) is that no one has ever found a butterfly of this species in hibernation, while there is hardly a single one of our butterflies which hibernates in the perfect stage of which there is not some record of its having been found; and yet the Monarch is nearly twice as large as any of these, and if it hibernates, would naturally seek similar hiding-places. It is by no means improbable, then, that in the winter this species does not exist north of, say, latitude 31°.

In further support of this theory may be mentioned its observed remarkable powers of flight, and particularly its commercial extension in recent years, which forms a chapter in its history quite exceptional for a butterfly. It has been seen flying at sea five hundred miles from land, and has within thirty-five years spread over nearly all the islands of the Pacific, and even to Australia and Java. Undoubtedly carried in the first place by trading or other vessels to the Hawaiian Islands and thence to Micronesia, it has unquestionably flown from island to island many hundreds of miles apart. It has also appeared at various times in different places on the seacoast of Europe, here also probably transported accidentally by vessel. In 1885, for instance, no less than nine specimens were captured in four different counties of England, and in 1886 it was reported at different points from England to Gibraltar. Indeed, it has been recorded as found in England in eight different seasons.

A special interest attaching to this butterfly is the fact that it belongs to a favored race, since, like all the members of its tribe, it is protected from its natural enemies among the birds by some nauseous peculiarities. The males can protrude from the end of the abdomen, on either side, a bunch or brush of hairs which may be the means of producing an offensive smell; but besides this, the whole body of both sexes seems to have a rank odor; and its protection is the cause of its unconscious mimicry by another of our butterflies, *Basilarchia archippus.* It is the best example of mimicry known in North America.

VANESSA CARDUI — THE PAINTED LADY

If the last butterfly discussed bids fair by its proclivities toward expansion of empire to become a denizen of all countries, the Painted Lady (Plate VI., Fig. 2), which we now take up, has already earned the name of "the cosmopolitan butterfly," for there is no other butterfly in the world with so wide a distribution. With the exception of the Arctic regions and South America, it is distributed over the entire extent of every continent. Australia and New Zealand produce a peculiar race, but the other large islands south of Asia possess the normal type, which is also found upon the small islands lying off the western borders of the Old World. On the other hand, Bermuda is the only island on either border of North America from which it has been reported, and it is also unknown in any of the West Indies. It was unknown until comparatively recent times in any of the Pacific islands, but now occurs both in the Hawaiian Islands and in Tahiti. On the American continent its southern boundaries will probably be found in Venezuela, New Granada, and Ecuador, except along the Andean chain, where it occurs even to Peru. It is abundant even as far south as the highlands of Guatemala, and thence stretches northward over the entire breadth of the continent nearly to the Arctic regions. On the eastern coast it has been found as far as the Atlantic shore of Labrador, on the west to British Columbia, and, in the heart of the continent, at Hudson Bay and the mouth of the Saskatchewan. In New England it occurs everywhere, even to the summit of Mt. Washington, and it has not infrequently been taken above timber in the Rocky Mountains.

It is a butterfly of medium size, the upper surface of the wings blackish-brown, marked heavily and irregularly with orange, and with a few small white and black spots ; beneath, the hind wings are heavily marbled and threaded with white, brown, and gray, with a series of more or less perfect peacock-eye spots before the margin.

It is very irregular as to its annual abundance, for even in districts where it is rather rare it may some year appear in great numbers. In New England it was noted as very common in 1878, was then very scarce until 1884, when it became extremely common, not only here, but over all the northern States, causing alarm for their crops among farmers unacquainted with its food-habits. This irregularity is sometimes due to immigration from other districts, for this is one of the butterflies whose migration in swarms is well known, and one flight which occurred in Europe in 1879 was abundantly observed, and shown to have proceeded from Africa. That its power of flight is great we know from independent sources, for it has been seen ninety and even six hundred miles from land, in the last instance during a cyclone.

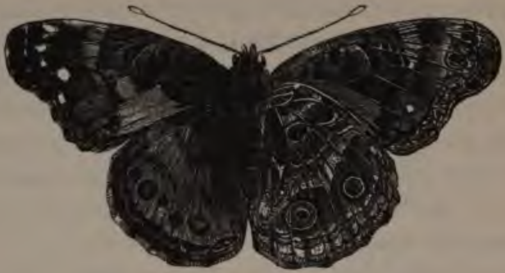
Notwithstanding the ubiquity and general abundance of this butterfly, its natural history is still imperfectly known. In New England it is double-brooded, and hibernates, so far as we know, only as a butterfly. In Europe authorities do not agree, but some think it also often passes the winter as a chrysalis. With us, the hibernating butterflies do not usually begin to emerge from their winter quarters until the middle of May, and badly worn specimens continue to fly until after the middle of June. They lay their eggs during the latter half of May and early in June; these hatch in six or eight days, and the caterpillars therefrom become fully grown between the middle of June and the end of July; the chrysalids hang from eight to fourteen days, and disclose the first fresh butterflies of the season about the 10th of July. These usually become abundant by the middle of the month, and at the end of the third week often innumerable; they continue to emerge from the chrysalis until the early days of August, and fly until the next brood appears; they lay their eggs during the last of July and the first of August, and the caterpillars undergo their final transformations in the latter half of August and early in September, the autumn brood of butterflies first appearing late in August, and continuing on the wing until the end of October, when they hibernate. In the south they fly all winter.

The eggs are barrel-shaped, a third higher than broad, with from fourteen to nineteen thin and high, vertical ribs, and pale green in color. When wishing to lay her eggs, the female butterfly alights upon a plant, and moves about with trembling wings until she finds a spot to her taste; the wings now become quiet, the tip of the abdomen is bent downward, and when it touches the surface the egg is laid. I once observed one alight many consecutive times on unopened thistle heads, thrusting her abdomen between the spines to the very sepals, as if ovipositing, but no egg was laid. The same butterfly appears never to lay more than a single egg upon one leaf, although she frequently deposits eggs on different leaves of the same plant; and in one instance I saw them laid on cut leaves lying on the ground; in this case they were laid upon the uppermost surface, whichever way the leaf happened to be turned; on the plant they are always laid on the upper surface, and I once found an egg on the spinous hair of a thistle leaf. Several eggs may sometimes be found on the same leaf, but they will always hatch at different times, showing that they were laid at different times, if not by different individuals.

Thistles are the favorite food of the caterpillar, and it will feed upon almost any kind, though it has its favorites, Carduus, Cnicus, and Centaurea, perhaps, as chief. It feeds also upon many other composite plants, such as Anaphalis, and in many places is especially fond of mallows. The young caterpillar makes its escape from the egg by biting a slit almost around the crown and lifting the lid thus formed, but does not appear to eat the shell, as many butterfly caterpillars do; after biting a few holes part way through the upper surface of the leaf on which it was born, it makes its way to the under side, and takes a position either between the midrib and curled-up rim, if near the tip of a thistle leaf, or, if farther back, next the midrib or a lateral rib, or between the tips of the crenulations of the edge; here it bites away the silken film of the leaf and makes a nest by covering itself with a slight open web, into which it weaves the bitten particles of the film; from this retreat it sallies forth to eat irregular patches in the parenchyma, which it often partially covers with an extension of the web.

Each caterpillar, when it has outgrown this confined abode, builds for itself a separate nest, generally near the summit of a stalk, and now lives on the upper surface of the leaf; it spins a thin web on the surface, near the edge of the leaf if it be a broad-leaved plant, and then draws over a portion of the leaf by means of threads, completing the covering with a silken tent; when half grown it forsakes this, and forms a more perfect nest, drawing together leaves, buds, and bitten fragments by the same process, so as to form an irregular oval cavity about an inch and a half long by a little more than half as broad. The narrow, irregular, crisped, and rather distant leaves of the thistles on which it is most frequently found cannot, however, be made to cover even a single caterpillar, so the spaces are closed by a thin, open web, through which the inmate can readily be seen, but which is sufficiently close to retain all the rejectamenta of the caterpillar. The nest is usually covered, at least in the upper half, with spines of the plant, evidently bitten off for the purpose and interwoven in the silk; an opening in the nest, near or at the summit, just large enough to allow the inmate to emerge at will, is apparently made by eating away the web; leaves which penetrate the nest are not lined with silk, but the web is frequently stretched across its inequalities. Here the caterpillar rests, head downward, and, when hungry, feeds upon the parenchyma of the upper surface of the leaves without touching the under cuticle, and when these are consumed, it crawls out to seek its fortune, and weave a more commodious mansion; when, however, it has reached its penultimate stage, it eats the entire leaf through.

If the caterpillar is born upon one of the broader-leaved forms of thistle, it constructs its home by first weaving a silken web across the narrower parts of the crinkled leaf, uniting the upper edges, but drawing them together very slightly. In such a passage it lives until nearly half grown, when it makes a web-nest, difficult to describe from its irregularity; it is a thin, silken inclosure of an oval, flattened form, with an opening at any point, the web covering the outer surface of a leaf, with



VANESSA HUNTERA — THE PAINTED BEAUTY

ANOTHER butterfly, of the same genus as the last, is distinctively American. It closely resembles the preceding upon the upper surface, but upon the under side of the hind wings shows, instead of a series of similar peacock-eye-like spots, only a pair of much larger and unequal peacock eyes, farther removed from the border; though it will be noticed that it possesses upon the upper side of the same wings a series of dark spots wholly similar to those in the Painted Lady, though a little farther from the margin.

It is apparently found throughout the entire extent of the United States, excepting Alaska, and possibly a portion of the central mountainous district, where it has been reported from only a few places. It is common in all the Gulf and Atlantic States, and has been brought from as far south as Indian River in Florida. Beyond our borders it is found throughout Mexico and Central America.

To the north, ignoring boundary lines, it has been taken in Nova Scotia, the Gulf of St. Lawrence, Quebec, Montreal, and Ottawa, the northern shore of Lake Superior, Minnesota, and Vancouver. In New England it is far more common in the southern than in the northern portions, and, notwithstanding that it is found on the St. Lawrence, and has been taken on the summit of Mt. Marcy, in the Adirondacks of New York, it is wholly wanting in the White Mountain district, and the localities where it has been found in northern New England generally are few.

It occurs, however, beyond the southern limits of the United States, and in an unusually irregular manner. Its presence far down the Florida peninsula accounts for its very rare appearance in Cuba, but its presence in the other West India islands, such as Hayti and Jamaica, is perhaps somewhat doubtful, though reported. Its abundance on our southwestern borders explains why it is everywhere common in Mexico and Lower California, and occurs plentifully as far south as the elevated plateaus of Guatemala. It is even reported from Costa Rica, Panama, Colombia, Bolivia, and Argentina. But the interesting thing is that the south Chilian and Patagonian *Vanessa terpsichore* is regarded by some as identical with our species. Still stranger is the report that in 1879 it was established on the Hawaiian Islands, and the repeated accounts of its discovery in Great Britain (never on the continent), and even on the

the interior can be gained. Beneath this the caterpillar devours the parenchyma of the leaf through to the under pellicle, and when it has devoured all that it can eat, it constructs a new nest, this time usually by folding together to a greater or less extent two adjoining leaves, and thereafter makes not infrequent changes of abode; probably, in the course of its life, quite as many as its changes of skin, though they do not appear to be in any way coincident with the moults. When the plants are still young and scarcely elevated above the ground, the half-grown caterpillar will sometimes construct a nest beneath the leaves, and in part directly upon the ground. So far as I have observed, it does not at this age leave its nest for food, but feeds apparently only upon the portions of the leaves inclosed within its web. In the autumn, when the flowers of everlasting are fairly opened, it almost invariably incloses them within its web, and picks these blossoms to pieces until they resemble cotton, apparently devouring the centre, and making a nest with the husks connected by a slight web, so that the naturally flat summit of a plant assumes a rounded appearance. Eating only the parenchyma of the leaf, it leaves the foliage crisp and blanched behind it, especially as when full grown the caterpillar quits its confined abode to feed in the immediate vicinity. In the last two or three days of its life, however, it devours the whole thickness of the leaves, and cares far less for concealment, though never so conspicuous and gayly colored as now.

It will be observed that the nests made by this caterpillar and that of the last species (belonging to the same genus) differ at different periods of life, and in very much the same manner, though built in very different material, in the one case rigid, in the other flexible. Another species of the same genus, however, makes, as we have seen (p. 81), one quite different, fastening together very weakly the opposite edges of the basal parts of a single large nettle leaf so as just to make them meet, but with threads so slight as to be ruptured with the slightest effort, forming thereby a roomy, bell-like inclosure.

It is a not uncommon habit with young butterfly caterpillars which live openly to carpet with silk a particular spot on the leaf on which they are living, to which they retire after each meal, and where they make their first moult. This may be regarded, perhaps, as the first stage in nest-making, when we observe that the caterpillars of certain Swallow-tails protect themselves from view by an exaggeration of this habit; these caterpillars rest upon the middle of the upper surface of a leaf, upon the floor of which they have stretched a silken carpet from side to side, each strand shorter than the last, so as to make the edges of the leaf curl toward each other, and sometimes even to meet, and thus form an open nest. Other butterfly caterpillars make a nest of a single leaf by biting channels into it to form a flap, which they then haul over by strands of silk continually shortened, and live beneath the canopy. Many kinds, too, form nests of many leaves more or less loosely or compactly joined, and some inclose the larger part of a branch in a web within which they devour the green leaves. But each species constructs nests after its own pattern at any given period of its life.

The caterpillar of the present species resembles that of the last in every respect but one, in which it is conspicuously different, namely, in having on each side a row of round silvery white spots, one to every segment on the posterior half of the body. The chrysalis, too, is very similar, but the tubercles are orange-tipped. The change from caterpillar to chrysalis usually, or at least often, takes place in the last larval nest.

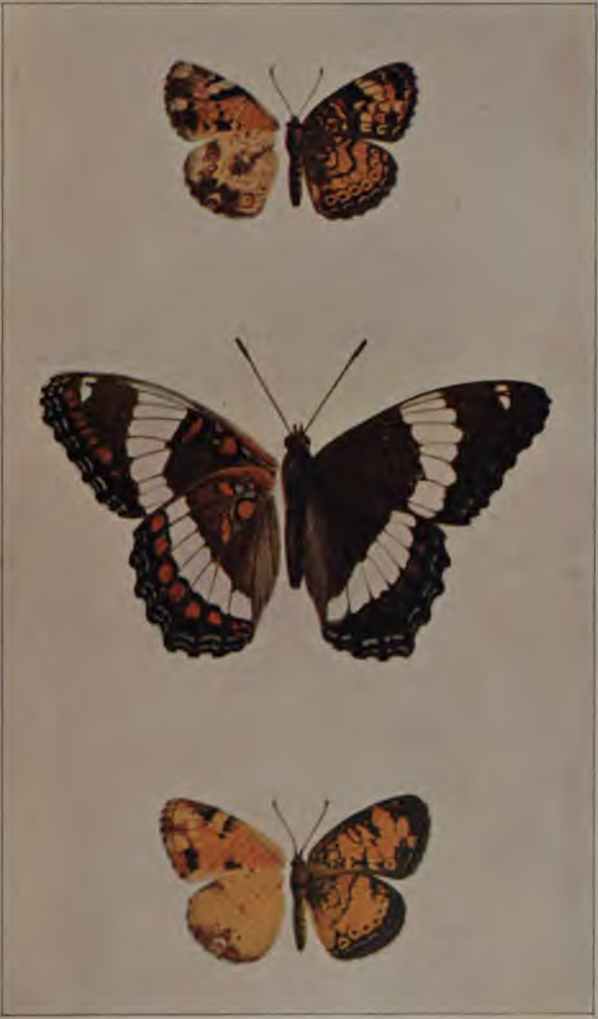
The habits and flight of this butterfly are much like those of *Vanessa cardui*, but, although considerably more abundant in some years than in others, it is much less subject to variation in this respect than that butterfly. It selects the same resorts, and is likewise very fond of thistle flowers, as also of dandelions; it has also a nearly equal activity, and will keep on the wing to within half an hour of sunset.

PLATE III

1. Phyciodes tharos, female

2. Basilarchia arthemis

3. Phyciodes tharos, male



PHYCIODES THAROS — THE PEARL CRESCENT

THE Pearl Crescent (Plate III., Figs. 1, 3) is one of the commonest of our smaller butterflies of the open country. The ground color above is fulvous, but it is heavily marked with black, wavy, transverse lines, which often merge into each other, and the hind wings have a row of black dots parallel to the margin. Beneath, the fore wings are orange-fulvous, and the hind wings brownish-yellow, both marked with irregular dark blotches and delicate transverse streaks, while at some little distance from the margin, especially on the hind wings, is a series of pale lunules often more or less silvery, one of them distinctly larger than the others.

It is found over the whole of the United States east of and including the Rocky Mountains, except in southern Florida, and also occurs in Canada from ocean to ocean, being found as far north as western Newfoundland, southern Labrador, Hudson Bay, the Saskatchewan River, and the Liard and upper Mackenzie rivers. In New England it is almost everywhere exceedingly abundant; it is not uncommon even in the White Mountain district, where I have taken it above the timber; but in certain years, at least, it is very scarce in some northern localities.

The eggs are light yellow-green, but little higher than broad, taper so that the summit is only half as broad as the base, with slight vertical ribs on the upper half, and shallowly indented like a thimble head on the lower half. They are laid in clusters on the under surface of the leaves of the food-plant, the clusters containing from fifty to more than two hundred eggs. One female I once imprisoned over a growing plant laid on a leaf about three inches from the top of the stalk a cluster of eggs closely crowded in a mass about twice as long as broad; there were about a hundred eggs in the cluster, most of them lying in a single layer about as closely crowded as possible; on the top of these was a second layer of about quarter as many, also closely crowded, but more irregular. They hatch in from four to ten, usually about eight days.

The caterpillar has a bronze head and black body dotted above with yellow, with a yellow band along the side, and armed with short yellowish spines, themselves armed abundantly with spinules. It feeds upon asters, and is apparently partial to *Aster novæ-angliæ.* The food-plant was for many years a puzzle, notwithstanding the abundance of the butterfly and its wide distribution. I have followed the females for many an hour in the vain search for some sign of its oviposition, a much more difficult task with those which lay eggs in clusters than with butterflies which scatter their eggs about, one at a time. It was at last discovered by experimentation.

In the only case observed by me, the caterpillars in exposed eggs hatched and moved away before those in underlying layers effected their escape; and it would seem as if this must needs be the case. Not the slightest web of any kind is spun, not even in crawling over the walls of their prison, which are less than half demolished in their escape, many crawling out when only the crown has been bitten around, a little below the summit, and pushed back far enough to permit exit, only to return to its place by its elasticity after the passage of the prisoner. Nor do they eat their cast-off skins, whether at the first or second moult, as many butterfly caterpillars do, but leave them lying like a spread mat on the leaf just where they walked out of them. There seems, indeed, to be a very general negligence in this regard among social caterpillars, where the necessity for it would appear most urgent. They feed in close companies always on the upper surface of the leaves, moving up or down, generally down the plant, as they need fresh pasture, and leaving a desert behind them. Even when eggs to the number of a hundred are laid on one of the smaller terminal leaves, it is fully twenty-four, perhaps thirty-six, hours after hatching before one of the caterpillars quits the leaf; the under surface of this single leaf suffices for all their wants for this time. They eat the parenchyma only, but not very cleanly, the leaves having everywhere little flecks of uneaten parenchyma, giving them a pitted appearance; this is in early life; they afterwards devour the whole thickness of the leaf, but still spin no web. They are very inactive, and cannot be roused to movement; at the most, they will coil themselves into a circle and drop to the ground. The caterpillars of the latest brood become lethargic soon after the second moult, but, under favorable circumstances, will continue feeding until October; or after a lethargic period may arouse, pass another moult, and again resume their lethargy. The caterpillars probably hibernate in any cranny they can find on the surface of the ground, as they leave the plant and wander more or less, but still to some degree in company. In this state, and in this state only, apparently, winter is passed. They must awake early in the spring, for sometimes, at any rate, they are full fed in Massachusetts by the middle of May.

The caterpillar attaches itself to any firm substance to undergo its final changes, but, under natural circumstances, apparently not to its food-plant. The chrysalis is slightly angulated, with a slight transverse ridge on the middle of the abdomen and rows of tubercles down the body. It is of a grayish color, the effect of brownish creases on a whitish ground, the abdomen darker. It generally hangs about a fortnight, but the period is known to range from six to thirty days.

In New England the insect is double-brooded, and passes the winter, as stated, in the third and fourth larval stages. Farther south there are one or more broods interpolated between these two. Near Boston the first brood of butterflies appears about the middle of May, though sometimes not until the fourth week; in central Connecticut I have found the species not uncommon, probably a week out, on May 15. As in the case with most species, the first brood of which is made up from caterpillars wintering when half grown, it does not rapidly become common, not before the very end of the month, and sometimes not until the first week in June; rarely, indeed, is it abundant before the first of June; females are, I believe, never taken before the 21st of May, and fresh females may always be taken after the middle of June. It often remains upon the wing, though in scanty numbers, until the new brood makes its appearance, and has sometimes quite disappeared by the end of the first week in July. The second brood is almost equally deliberate in its progressive advent; the males and females seem to appear at the same time, the earliest between July 12 and 18; both sexes continue to emerge uninterruptedly from this time until the end of August, so that some observers have supposed there must be here a third brood; there is, however, no break whatever in the appearance of fresh females, and the unusual length of time during which they continue to emerge from the chrysalis seems to be due, first, to the individual difference of habit in hibernating caterpillars, spreading the first brood over an unusual period; second, to the sluggish habit of the insect; and third, possibly, to lethargy in midsummer caterpillars, though this has never been observed at this season. The butterfly usually disappears by the middle of September, but I have taken specimens as late as October 13. The caterpillars stop eating and go into hibernation early in October.

In northern New England the periods are somewhat later, the first brood appearing in scanty numbers in the first week of June, and rarely being common before the 10th, sometimes not until the middle of the month. The second brood also disappears earlier, none being seen by me after August 20 in one season spent at Plymouth, N. H. To the south there is not any noticeable difference between Nantucket and Boston, but further south there is undoubtedly an intermediate brood, though even in West Virginia the earliest appearance on record is only May 18.

An interesting feature in the history of this butterfly is the lethargy of the caterpillars already alluded to. Most of the experiments have been made by Mr. Edwards, who finds that in West Virginia this peculiarity does not appear in the earlier broods, but only in the last two broods of caterpillars; and, while invariable in those of the last brood which winter, but sometimes become lethargic as early as the end of August, it also appears in the caterpillars of the preceding brood, some of which become lethargic in very warm weather, while the greater number proceed regularly, like the caterpillars of the preceding brood, to chrysalis. The following are some of the experiments: —

Caterpillars from eggs laid in the north at the end of July, and therefore of the second brood of butterflies, all became lethargic after the second moult, or about September 4; but two weeks later part of them resumed activity, fed a few days, passed another moult, and then became lethargic again; these were placed in a cellar and remained without change through the winter. Again, eggs laid in West Virginia in the middle of August were taken to the Catskills, New York, where they hatched on the 20th; after the second moult about forty per cent. became lethargic, while the remainder continued their changes until the butterflies appeared, September 15 to 26; some of the chrysalids kept in a cool place gave out butterflies at the end of October. All this is of course not what happens freely in the Catskills under natural conditions, for it is safe to say that no butterflies emerge there as late as the middle of September. But it is interesting to note that about one half of the forty per cent. which became lethargic began to feed again about September 26, passed another moult, and then resumed their lethargy. A third experiment showed that eggs laid in the Catskills at the end of June by butterflies of the first brood, and carried to West Virginia, hatched there July 3, and most of them gave butterflies by the end of the month, but a portion even in this southern locality, about five per cent., became lethargic after the second moult, a thing which has not been found to occur with native West Virginian caterpillars at that season. This leads one to conclude that in the north probably a portion of the caterpillars from the first brood of butterflies become lethargic, and continue so until the following spring; that is, that the species is here partly single-brooded and partly double-brooded, and that in the northernmost part of its range, to judge from the short season and the known dates of its flight, it is single-brooded only. This conclusion is in the highest degree probable, and the proportion of the caterpillars from the first brood of butterflies which develop directly into the second as we pass from north southward would be a very interesting subject for investigation.

Another interesting feature in this insect is its dimorphism, a seasonal one, inasmuch as wherever there are two or more broods, the first or spring brood differs from the others mainly in the heaviness of its markings, so that it was at one time thought to be a different species; occasionally, however, the spring form has been taken in the later broods, and especially in specimens disclosed toward the very end of the season, leading to the conclusion that cold has much to do with its appearance; and this conclusion has been proved by direct experimentation, subjecting chrysalids to artificial cold directly upon their formation, when, at any period of the year, they bring forth butterflies of the spring type — not invariably, but in very large proportion.

The butterfly may be seen in almost any open, sunny place, on weedy hillsides, or among the ranker vegetation following the course of small streams. It is partial to flowers, especially such as grow in low, damp ground. It is fond, too, of wet spots, assembling by hundreds with other thirsty butterflies. Its flight is invariably slow, in keeping with its character, and for short distances only. It is in no way pugnacious, as are many other butterflies, nor do the males pursue and tease the females to the same extent; but each seems rather intent upon a little more honey, and willing rather to let alone and be let alone. All this is in entire keeping with its sluggish nature through life.

PAPILIO POLYXENES — THE BLACK SWALLOWTAIL

From its size and striking appearance, and from its feeding in early life on garden vegetables, this butterfly is familiar to every one. It is the first of the northern Swallowtails to claim here our attention. The upper surface of the wings is black, and bears a marginal series of yellow spots, round on the fore wings, lunate on the hind; crossing both wings is a series of more or less connected yellow spots, forming a more or less distinct band; the hind wings have also a red ocellus, with a black pupil at the anal angle, and between the two rows of yellow spots the wings are dusted conspicuously with blue; the sexes differ on the hind wings in that the inner row of yellow spots is much more conspicuous in the male than in the female, while the reverse is true as to the blue dusting. Beneath, the markings are similar, but the yellow is replaced largely by orange-red, especially on the hind wings; the latter bear near the middle of the hind margin a long and slender tail.

The history of this butterfly is somewhat different in the northern and southern States. In the south the butterfly hibernates, and lays eggs in the latter half of March and throughout most of

April, at the end of which month the hibernating butterflies have disappeared. The eggs hatch in ten days, the caterpillars feed for three or four weeks, the chrysalids hang for from twelve to sixteen days, and a first brood of fresh butterflies appears the last of April. A second brood, after remaining an equal time in chrysalis, appears in July, generally, it would seem, in the latter part of the month; and a third, the chrysalis state of

which is shorter by several days, before the middle of September; fresh specimens continue to emerge from the chrysalis until the end of October, and these all hibernate. The perfect insects may therefore be seen throughout the year, excepting in one or two winter months, when they are in concealment.

In the north, on the other hand, the butterfly is only double-brooded, and winters as a chrysalis. It appears on the wing in May, generally about the 21st, seldom before the 15th, occasionally as late as the last days of the month; in northern New England and corresponding latitudes it sometimes appears as late as the end of the first week of June. The female begins to lay eggs after the first week of June, and continues to do so until the brood disappears early in July, or sometimes late in July in Canada. The eggs hatch in eight or nine days, and the caterpillars become full grown between the 10th of July and the end of August, and, in from twenty to forty hours after the completion of the girth, slough their integuments and become chrysalids; the duration of this state seems to be variable, ranging from eight to eighteen days, but the average seems to be ten or eleven. The second brood appears generally a little after, occasionally shortly before, the middle of July, and continues to emerge from the chrysalis until the end of August, and to fly until at least the middle of September. The eggs are laid during August, and the full-grown caterpillar may be found during the whole of September, and occasionally also during the latter days of August; the chrysalids from these hibernate. The butterflies may, therefore, generally be seen from the middle of May to the middle of September.

The eggs are smooth, honey-yellow globules without markings, as they mature changing in color in parts to reddish-brown, and are laid singly on the upper (rarely the under) surface of the finely cut leaves of umbelliferous plants, never more than one on a leaflet, though they may sometimes be found on closely adjoining leaflets; they are generally attached either to the midrib or to one of the side ribs. The female in ovipositing settles gently on the end of a leaf, holding thereto with her feet for a few moments, then curves her abdomen forward, places an egg on the leaflet, and gently flies away to another leaf. The duration of the egg state in the extreme south may be reduced to as little as five days.

The little caterpillar when born, and indeed for the first three stages, has a wholly different appearance from the full-grown creature; it is angulated, covered with spiculiferous warts in longitudinal rows, and of a black color, with a white saddle across the middle. When full grown it is cylindrical, smooth, and naked, green, transversely striped with black bands in which orange spots are arranged in longitudinal series. The caterpillars are thus very conspicuous objects, the more so as they live fully exposed on the upper surface of the leaves of their food-plant.

This change in the shape and clothing of a caterpillar between infancy and maturity is not only common but universal, though to varying degrees of contrast; it is, however, not often accompanied by marked changes in coloring and pattern except among the Swallowtails, and the change of clothing is ordinarily made with the casting of the first skin of the caterpillar. The minute creature just out of the egg, with its embryonic clothes on, is invariably an animal of totally different aspect from its mature self. It is, however, so diminutive, and has been so little studied, that it is only in recent years that this fact has become known, and only now that naturalists are beginning to use it in their study of the relationships and phylogeny of different forms. The field of study thus opened will undoubtedly prove a fertile one.

From the great diversity in the character of the metamorphoses of insects in general and the nature of the differences between them, it has been argued, and is generally believed, that all these metamorphoses, and in particular such complete changes as are undergone by a butterfly during its varied life after leaving the egg, are acquired characteristics, gradually gained by adaptive devices in the struggle for existence; that is to say, there were perfect insects before there were caterpillars and chrysalids, or, indeed, larvæ and pupæ, properly so called, of any kind. In this case we should reasonably look among those insects in which metamorphosis had been carried to its highest pitch, such as butterflies, for some indication of its advancing development. Now inasmuch as the inert chrysalis is as complete an example of adaptation to its purpose as can well be conceived, where between the two ends of the scale could be interpolated any further metamorphosis than in the growing and feeding caterpillar, with its frequent changes of skin? And if metamorphoses were originally acquired to fit the creature for the contrasted circumstances of its earlier and later life, can we be far wrong in assuming that the conditions of existence are very different in the case of a young creature just from the egg, so small as hardly to be seen, and its full-grown self, one hundredfold as large, able to pass rapidly from an exposed to a concealed position? May we not, then, look upon the distinctive clothing which juvenile and mature caterpillars of butterflies possess, features common to all the members of the group, as the first step toward a further stage of metamorphosis, — a sort of hypermetamorphosis, as it might be called?

But to return to the particular caterpillars of the Black Swallowtail. They feed, as has been hinted, upon umbelliferous plants, and will probably eat any of our native or introduced species, but seem oftenest to be found upon parsley and carrot, perhaps because these are the commonest of the cultivated sorts. They eat voraciously, especially in their last stage, and may double in length in twenty-four hours by gorging, and increase their weight tenfold in the same time. They feed in plain view, and when wishing to moult, especially in their later stages, appear to mount to the outer surface of the plant to gain the fullest exposure, perhaps to avoid the danger of being rubbed at that sensitive time by the neighboring leaves moved by the wind. They generally cast their skins early in the day, and do not devour the cast-off pellicle. The scent-organs, or osmateria as they are called, Y-shaped protrusile, fleshy tentacles just behind the head, are protruded at rather slight provocation, but rarely to their full length; they emit a moderately strong odor, not unlike that of the bruised leaves of parsley.

When it wishes to pupate, the caterpillar entangles the anal prolegs securely in a mat of silk, spins a loop in front, crawls underneath this, and curves the head and front part of the body so that the front of the head strikes the surface to which the ends of the loop were fastened, and the cord passes between the second and third abdominal segments. It remains thus for at least twenty-four hours before the change to chrysalis is effected, when the cord sinks so deeply in the soft pupal skin as to be firmly imbedded in it when dry; from its length it allows considerable swing to the chrysalis. This is of a wood-brown color, more or less tinged with greenish and streaked with black, which, with its rough surface and ragged-looking anterior extremity, closely resembles a bit of rough bark.

The butterflies are very fond of flowers, and are active agents in their fertilization. The Agricultural Department at Washington even charges that they damage the verbena from their too frequent visits, since in withdrawing the tongue they pull the flowers all to pieces! When on the wing they course about meadows and pastures, taking first one direction then another, frequently half doubling on their course, and so returning at last to the same place they have repeatedly visited. Ordinarily they fly not more than a foot above the herbage, or indeed above the ground, in a well-cropped pasture. When alarmed, however, they go at great speed, zigzagging rapidly, with occasional upward and downward starts thrown in, kept up even when the pursuer or the moving object which caused the fright may be far in the rear.

The Black Swallowtail is found throughout the United States, but is rarely found in the Rocky Mountain region, where it is largely supplanted by another species of the genus. It extends throughout Florida, and is also found in Cuba, Hayti, and San Domingo, as well as in Mexico and a considerable part of Central America. To the north it does not occur far beyond our borders, and is curiously supplanted by a closely allied short-tailed species in Newfoundland, southern Labrador, and Anticosti. It is pretty uniformly common throughout New England.

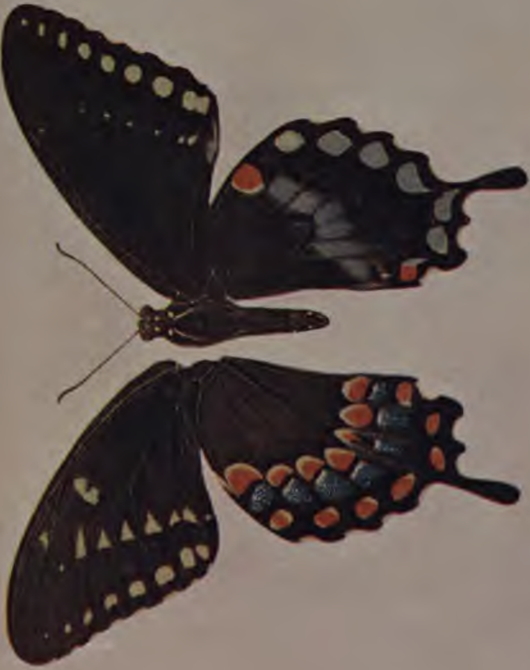
EUPHŒADES TROILUS — THE GREEN-CLOUDED SWALLOWTAIL

This is a large black butterfly of striking appearance (Plate IV.), with a tail to the hind wings which is spatulate, and twisted at right angles to the plane of the wing; both wings have above and below a row of marginal spots, which are pale above, orange beneath, at least on the hind wings, while a bright orange spot occurs at the anal angle of the hind wings, and also near the middle of the front margin of the same, these two spots forming, beneath, the outer members of a row of similar spots parallel to the outer ones; between these two series, beneath, or in the place of the inner series above, the hind wing is heavily dusted with bluish or greenish scales.

It is typically a southern butterfly, but ranges pretty far northward, being found almost or quite throughout the United States east of the Mississippi valley, except some of the northernmost portions, and including, in Canada, southern Ontario. It has, however, been reported from Fort McLeod, Alberta, so that its northern range may be farther than here indicated. It fails in eastern Canada, but it occurs through all but the northernmost parts of New York, and I have taken it as far

PLATE IV

Euphœades troilus



north in New England as Sudbury, Vt., and it has occurred at Suncook, N. H.

The insect is double-brooded throughout its range, and passes the winter in the chrysalis state. The earliest butterflies appear in the south in the first half of March, in the north in the latter half of May; the female appears a week later than the male, and butterflies continue to emerge from the chrysalis all through June, and are seen far into July. The eggs are laid early in June, the caterpillar passes about a week in each stage (a month for all in Florida), and changes to chrysalis by the middle of July at the earliest, or in the south in the latter part of June; it continues a fortnight or more in this condition, and a second brood of butterflies appears, in the south in July, in the north seldom before the middle of August, but sometimes at the very end of July; it becomes abundant in the latter part of August. The full-grown caterpillar of this brood may be found from the first week of September, or even earlier, until the middle of October, when they change to chrysalis and thus hibernate.

The eggs are nearly spherical, smooth to the naked eye, and pale green, about a millimetre in diameter; they are laid singly, nearly always on the under side of leaves, on the apical half of the leaf far from the edge; the leaves chosen appear to be generally near, but not at, the tip of a shoot, and small trees or bushes are preferred.

The caterpillars as they leave the egg are, as in the last species, very different in appearance from what they grow to be; the body is leaden-colored, and angulated with spiny warts along definite lines, one pair of which project forward like ears on either side of the head; when mature they are nearly cylindrical but swollen in front, green above, reddish below, the body smooth and naked, but adorned with small colored spots, which for beauty will bear the closest inspection, there being on either side a row of black-edged turquoise spots, which on the swollen part of the body are contained in black-edged buff spots also adorned with velvety black. Their ordinary food is spice-bush and sassafras, but they have also been found on various other plants, such as red bay, prickly ash, cherries, and even on lilac and sweet potato, so that they have the chance of a very varied diet.

When it first comes from the egg, the young caterpillar, after devouring its shell, bites a channel down one side of the leaf on which it was born in an oblique direction toward the midrib, then folds over the flap thus obtained upon the upper surface of the opposite side, and lives in the depth of the concealment thus formed. No silken threads fasten the edges together, yet the edge of the flap is pressed firmly upon the opposite side, solely by the repeated crossings next the midrib of transverse strands of silk, so as to form a dense, glistening, whitish carpet, thickest in the middle, and extending the whole length of the inclosure. If forced open, the flap at once regains its former position when freed, showing the tenseness of the silken strain. The deepest part of the nest thus formed is somewhat cylindrical, so that an opening is found at the end away from the tip of the leaf, through which the caterpillar finds ample room to creep even after it has passed its first moult, which it does in this chamber. I have found them in such a nest even up to the beginning of the third stage. It is by no means rare to find such nests with a channel cut down to the midrib on both sides of the leaf, as if it had proved difficult, with a single channel, to draw the two sides of the leaf together. The caterpillar feeds upon the same leaf, outside its nest, gnawing great holes out of the sides, but before this leaf is nearly consumed, it passes to a fresh leaf to renew its operations. Being now larger and stronger, it makes its nest in a new way, without first preparing a flap. By the same method of weaving the silken floor of its proposed abode, and by forming its track far to one side of the middle of one half of the leaf, it folds one portion of the leaf over upon itself, so as to make the edge of the bent portion fall upon the upper surface of the leaf upon the same side of the midrib, and so constructs a long and rather narrow flattened cylinder, in which the edge of the leaf is in every part closely appressed, but not fastened, to the surface, and out of which it can crawl at either end. From this retreat it passes at will to feed upon the neighboring leaves, very rarely upon that it has selected for its abode. When this has become too strait for its rapidly growing body, it forms another of similar nature but of larger size, the edge falling upon or beyond the midrib; and finally, in its last stage, or sometimes earlier, it takes up its position upon the midrib itself, and by the same procedure causes the opposite edges of the leaf to exactly, or almost exactly, meet above its head, still with no fastenings, leaving only a passage out, and a very confined one, next the leaf stalk. It thus passes its entire life, when not feeding or house-building, in entire concealment, undergoing all its changes within the cleanly home, where it drops no excrement and suffers none of its cast-off clothing to remain, eating up its cast-off skin, and hustling its no longer needed skull-cap out upon the ground.

The ordinary movements of the full-grown larva when exposed to view have an absurdly affected look. It moves, or seems to glide, by little starts about a second apart, in a very slow and measured way. Evidently it is no necessity of its organization, but a superinduced habit for some protective purpose, probably in correlation with its great thoracic spots and swollen front. This panting, spasmodic approach of so singular-looking an object may be a cause of fright, possibly of fascination, to some of its natural enemies, sufficient to protect it until it once more gains cover. It seems to have less inclination than our other Swallow-tails to protrude its scent organs, which give out a musky odor, rarely thrusting them out to their full extent.

The chrysalis is relatively smooth, with no striking prominences except a pair of diverging frontal projections and a ridge in the middle of the back; it may be either pale greenish or griseous.

The butterfly generally emerges from the chrysalis early in the day, and the first signs of the immediate change are strong forward and backward movements of the chrysalis at intervals of a few seconds; perhaps the third or fourth attempt will be successful, when a click may be heard at the distance of several feet; but all the subsequent movements are absolutely noiseless, though rapid; at intervals of three or four seconds, spasmodic movements similar to the first carry on the process: first the split continues along the thorax; then it runs down either side between the legs and wings, ultimately to the tips of the antennæ. As this progresses, the actions become more strenuous and more frequently repeated; with eager efforts the butterfly pushes forward its half detached head; now an antenna springs from its case, at once assuming its natural attitude; the other soon follows, and then the wings are partially drawn from their sheaths, and while in this position seem to be used as levers or arms to aid in withdrawing the rest of the body; next the legs appear, seize the upper part of the chrysalis skin, and speedily withdraw the whole body. It is now a curious-looking object, the wings wrinkled and bloated, and, although the whole process of escape lasts little more than half a minute, already twice the size of the sheaths they lately occupied. The insect crawls upward until it finds a secure resting-place, and there remains until ready for flight; each half of the tongue, drawn independently from its receptacle, is rolled in a separate spiral, and now while the wings are gradually expanding, the insect applies all its energies to uniting their two parts, incessantly rolls and unrolls them, and beginning simultaneously at the base, gradually fits them together by their interlocking joints; in about fifteen minutes all but the tips are perfectly united; these require nearly fifteen minutes more, and are not fairly interlocked until the wings are fully expanded, nearly a full half hour after the escape from the chrysalis; the wings, however, are still tender, and generally require two hours to stiffen. When at last the insect ventures upon flight, it is not with an uncertain flutter, but boldly and steadily, as if long accustomed to the action.

The butterfly is usually found in the vicinity of woods and groves, particularly in damp, open woods and about marshy thickets. Its flight is free and graceful, generally remaining only a few feet above the ground as it courses rather swiftly above the bushes, dropping constantly here and there, and pausing in its onward flight to examine every little nook for the flower or plant it seeks; rarely alighting, it seems never weary, and passes back and forth in long zigzags across a field, with constant revisitations of the same spot.

This insect is a good example of the universality of the rule that, in their early stages, all butterflies are more or less protected from attack by their resemblances to their surroundings. The pale green egg is like a globe of dew upon the green leaf, having just such color as this would have by reflection. The caterpillar, although living most of its life in concealment, is, at least when of any considerable size, of a leaf-green, with a darker color beneath, as if by a cast shadow ; and since a moving object is far more conspicuous than one at rest, it glides forward in the manner described by nearly imperceptible starts, so as not to attract attention by its movements unless one's eyes are fastened upon it. Later, when it wishes to change its skin to become a chrysalis, the caterpillar, like others of this group, first ejects the entire contents of the alimentary canal, and thereafter its color undergoes a decided alteration, the green changing to yellow, closely resembling the color of a sassafras leaf touched by the frost. The chrysalis again is protected by its color, being either green like a growing leaf, or of a gray color like the bark of a tree.

LIMOCHORES TAUMAS—THE TAWNY-EDGED SKIPPER

THIS is the first of the smaller Skippers to claim our attention, as it is the earliest of them. The group is rich in species with us, far more so than in Europe, this being one of the distinctive features of the butterfly fauna of eastern North America. This butterfly is perhaps the most common, as it is one of the most insignificant, of them all, and one of the most widely spread. Abundant everywhere in the northern States east of the Rocky Mountains, it occurs also as far south as Virginia and Kentucky, and has even been brought from Florida and Texas. To the west it occurs abundantly, not only as far as Wisconsin, Iowa, Nebraska, and eastern Kansas, but also, at least beyond our border, to the Rocky Mountains; and in our own territory is known from Dakota, Montana, Colorado, and New Mexico. Northward it occurs throughout the inhabited parts of Canada and beyond, from Quebec, Cape Breton, and Nova Scotia to Nepigon, north of Lake Superior, Assiniboia, and Alberta. In New England, as might be expected from this statement, it is everywhere common, from the White Mountains, and even from the highest peaks of the same, to the southern and eastern seacoast.

It is, as I have said, of insignificant appearance, expanding but little more than an inch, of a dark brown color above and below, the fore wings with a tawny front edge, the female with a row of squarish pale spots across the middle, and the male with a black, sinuous, heavy stigma in the middle above.

The butterfly is double-brooded in the central part of its range, single-brooded in the northern, and in both passes the winter as a chrysalis. The first generation makes its appearance in Massachusetts during the last week of May, usually between the 20th and the 25th; in a week it becomes abundant, and by the middle of June most specimens taken are badly rubbed; a week later it begins to diminish rapidly, and yet a few specimens may often be found throughout July. Early in June the females begin to lay their eggs, and continue to lay them until the middle of July. The second brood of butterflies, which is usually less abundant than the first, appears near the end of the first week in August, sometimes during the last week of July, becomes abundant in about a week, lays its eggs from at least the middle of the month onward, and continues on the wing until the latter part of September; the caterpillars from these eggs probably change to chrysalis before hibernation. It is quite improbable, however, that caterpillars from eggs of the first brood laid as late as the middle of July mature rapidly enough to reach chrysalis in time for it to disclose the butterfly the same season, and this will account for the scarcity of the second brood, which is found as far north as Ottawa. In northern places with late springs, like Nova Scotia and Lake Superior, the insect is certainly single-brooded; caterpillars from eggs laid early in July probably never mature so as to reach chrysalis until late in the season. In one instance, eggs laid in Nepigon in July and carried to Ottawa hatched in thirteen days, the first moult was passed eight days thereafter, and the caterpillar lived for only a week less than three months, changing to chrysalis the middle of October; yet all the later moults were passed in the month of August.

We are, indeed, not yet fully informed regarding the life history of this butterfly. The story given here is almost wholly dependent upon observation of the time of appearance and condition of butterflies taken in the open air at different times and in various places. Its apparition in fresh condition at two different periods of the year, at least in the southern half of New England, is unquestionable; but the behavior of caterpillars obtained from the earliest and latest eggs of the first brood under perfectly natural conditions needs to be carefully observed, and the dates of eclosion of the resulting butterflies compared with the occurrence of the butterfly out of doors, before we can determine to how great an extent the insect is single or double brooded in different places.

The eggs are smooth, hemispherical, and pale green, and are attached lightly to grass blades, indifferently upon the upper or under surface, at least in confinement; they hatch in from eleven to fifteen days. The young caterpillar is slender, white, with a large black head, the last segment with some long, recurved bristles twice as long as the width of the body. When full grown it is less slender, still with a black head, the body naked but briefly pilose, of a rich purplish-brown with a green tinge. It feeds upon common grasses, eating any offered in confinement, but with certain preferences. It is an indolent and yet timorous creature. It requires, to begin with, a great deal of time to escape from the egg, often twenty-four hours; it appears to feed only by day, and retires at the least alarm, curling up if disturbed when away from its nest, but rarely leaving it, and then but a short distance, and eating the driest blades rather than go farther for fresher material; it is a most passive creature. One reared in Canada spun in its last stage, but six weeks before pupation and long before it had stopped eating, a light but strong web like a small cocoon of a moth of the genus Catocala.

Mr. Fletcher gives the following account of his experience in raising the caterpillar: "I kept it in a glass tube for better examination, and it turned out to be a very interesting captive. Instead of making a tent by catching the opposite edges of leaves together, it spun a nest against the side of the bottle, and would extend itself from the nest and eat its food. After the third moult, it was removed to a tin-topped jelly glass. Here, too, it spun a cocoon-like nest, from which it reached forth and ate its food. On September 8 it appeared sluggish, and I thought it was going to pupate. It was almost an inch long, and I knew must be full grown, so it was placed in a tuft of grass, where it very soon spun a cocoon amongst the leaves close to the root, and remained in a semi-torpid condition, sometimes coming out on warm days and eating a little. On the 13th of October I found it had pupated. . . . The chrysalis, which was contained in a light cocoon about an inch long, made by catching a few blades of grass together and lining them with silk, was almost erect, and seemed to be kept from lying against the cocoon by a few strands of silk." The chrysalis is slender, smooth, light brown, with a tongue-case extending nearly to the tip of the body.

The butterflies frequent open fields, meadows, roadsides, pathways, and exposed sunny spots. They are fond of flowers, and have been found trapped in a cypripedium; when feeding upon a flower, the fore wings are usually so much raised as to be at right angles to each other, while the hind wings remain horizontal. They have the skipping flight common to this group of butterflies, and from which they derive their common name.

THORYBES PYLADES — THE NORTHERN CLOUDY-WING

THE only larger Skippers, or Hesperini, that we have yet discussed are species of the genus Thanaos, which winter as full-grown caterpillars. We now come to one of later appearance, but which winters as a chrysalis, by which we should have surmised its earlier apparition. It is a very sombre-looking insect, of a dark brown color, with a spread of wings of fully an inch and a half, the wings broad and ample, with very simple and slight markings, consisting largely of a few white flecks scattered mostly in an irregular line across the middle of the fore wings, and a couple of parallel and inconspicuous dusky bands across the under side of the hind wings.

It is double-brooded in the northern United States. It first appears as a butterfly toward the end of May, rarely earlier than the 24th, and usually not until the 27th or later. It becomes abundant in about five or six days after its first apparition, but the male is always so much more abundant than the female that even toward the middle of June, when the latter is laying eggs in large numbers, this is outnumbered three to one by the male; bad weather in the latter part of

June will diminish the number in flight by seventy-five per cent. in a few days, but a few always linger on until at least the middle of July, and in elevated districts until the end of July. The eggs are mostly laid in the latter half of June, the caterpillars may be found half grown before the middle of July, and fully grown from the 20th of the month until the early part of September. It remains in the chrysalis state about twenty days, and the second brood of butterflies, which is much less abundant than the first (probably because many chrysalids continue until the next spring), appears in August, sometimes as early as the beginning, but usually not before the middle of the month, and continues on the wing until past the middle of September; whether the progeny of this brood reaches the chrysalis stage before winter approaches has never been learned; if not, it probably perishes altogether.

From the south the data are meagre, but what there are show that the butterfly appears in Florida in the latter part of March and begins to grow scarce by the middle of April, so that a larger number of broods there is highly probable.

The eggs are subglobular, but with a broad base, ornamented with about fifteen vertical ribs in low relief, and very pale green, almost white; they are laid singly on the under side of leaves. They hatch in from five to ten days, or perhaps longer in the latter part of June, ordinarily about six days. While laying her eggs, the female flies in and out among the herbage at less than a foot above it, stopping very frequently as if intending to alight, poising her heavy body with rapid fluttering of the wings, and apparently touching the plants with her feet to feel their character; finding a clover leaf suited to her inclinations, she alights on the under surface with her head next the edge, and, remaining on the leaf about three seconds, deposits a single egg somewhere near the centre. She seems to select clover leaves having an independent stalk, standing rather high, and to prefer those which are either in a thick clump, or are sheltered to some degree by shrubbery or rocks. She always flies to some distance before depositing another egg, and such as are found on leaves in the near vicinity must always have been laid by different individuals, or by the same on subsequent visits to the spot. Nothing would seem more hopeless than a hunt in a clover-field for eggs of this butterfly, but in the proper season they may be found with the greatest ease, after a little practice.

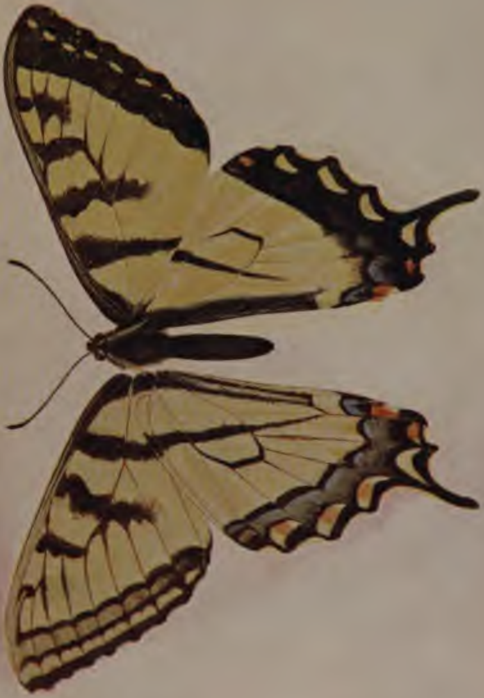
The little caterpillar which creeps out of the egg is white, with a black head and dark collar, the head of greatly disproportionate size, and the body slender and nearly cylindrical, with a few rows of widely separate dusky bristles as long as the segments. When full grown the head, still black, is not too large for the body, while the latter is plump, naked, and briefly pilose, tapering considerably toward either end, the neck strangulated, the body dingy green, with dark and pale salmon stripes.

It probably feeds on almost any leguminous plant, but its common food appears to be Trifolium and Lespedeza; the common red and white clovers seem to be most sought. On emerging from the egg, the caterpillar usually devours only the upper half of the shell, and then travels to another leaf, and at once prepares a nest. It first bites two narrow and parallel slits, about quarter of an inch deep and the same distance apart, near the middle of one side of the leaf; in so doing it takes its first green meal. The piece thus partially detached is then bent over to the upper surface and attached loosely by silken cords, and the caterpillar crawls within, secure from observation and the sun's rays. Similarly constructed retreats answer its purpose as long as one leaf is large enough for the growing body, but it finally makes a more complicated nest from several leaves pulled together and attached by silken cords. It is cleanly in its habits, always retreating a few steps to the edge of its abode, and elevating the terminal segment of the body slightly to snap away its ejectamenta. When taken from its nest and placed on fresh leaves, it never ventures a step without lining the leaf with silk, moving its head from one side to the other as if it were searching for something between its front legs. While at its meals it retreats slowly, eating with its body turned so that its head is near its tail, and devouring the leaves close down to the midrib; both when eating and when moving about, the head has always a palsied motion. It will go a long time without food. I once carried some caterpillars across the ocean and followed their latest developments in Europe, though their food in the latter part of the voyage consisted only of dried leaves; and one instance is on record of a caterpillar in captivity for four weeks without fresh food, and living at the end of it, though it ultimately died.

The chrysalids are slender and rounded, with a short abdomen, and of a brownish-yellow color, and not unlike that of some moths in general aspect. They are inclosed in slight cocoons, those which I have seen, constructed in captivity, being made by fastening clover leaves together by a few strong silken threads so as to form cells scarcely longer than the chrysalis, but several times its size. The chrysalis is entirely concealed from view by the leaves, and in one case the threads supporting the hook at the hinder end of the chrysalis were pretty closely appressed to the end of the cell and crossed each other like an X, into the centre of which the hook was plunged; the loop on which the body is slung, however, takes the form of a Y with a short stem, the swing being fastened by its middle to the lower surface of the cell; sometimes the threads at the hinder attachment form a Y with the stem

PLATE V

Jasoniades glaucus



though it appears to require the occurrence of a third, or at least of a second, brood to develop this antigenic quality, the feature is not at all confined to the later broods, but occurs to an equal extent in the spring brood. From its geographical limitation to regions where the species is more than single-brooded, we should naturally presume that this variation first arose in a summer brood; that it should have extended so as to include the spring brood to an equal extent, and yet never to include the male, nor to have spread to regions where the species has but one brood, is certainly surprising. Weismann presumes this to be a case arising from sexual selection, but there seems to be not the slightest ground for such a belief. May it not be compared rather to those cases of mimicry, or of protective resemblance, often confined to the female sex, as the most needy object? The black female must be a less conspicuous object than its gayly banded sister; and its restriction to the south is in keeping with the greater prevalence there of insectivorous creatures.

It is more widely distributed than any other of our Swallowtails, for it is found in nearly every part of North America, from Atlantic to Pacific, from Newfoundland to central Florida, and from Alaska to California. In the Gulf States the dark form of the female occurs to the exclusion of the yellow; it prevails as far north as West Virginia and southern Illinois; a little farther north it begins to be rapidly supplanted by the yellow female, but straggling specimens have occasionally been taken as far north as Long Island, northern Ohio, and southern Ontario; while the farther west one goes, the farther north it is found, as in Wisconsin and even in Alberta.

In its season, the Tiger Swallowtail is in many places one of the very commonest of butterflies; it appears to swarm in mountain valleys. It is so attracted by certain flowers and by decaying animal substances as sometimes to collect literally by thousands, and when startled, to fill the air with a yellow cloud. Once, on a cluster of lilacs, sixty-nine specimens were captured at once by closing the two hands over them.

In the northern United States, this butterfly is double-brooded, but it is triple-brooded in the Gulf States, and doubtless only single-brooded in the high north and as far south as Lake Superior. It always hibernates in the chrysalis state. In the south, the butterflies of the different broods appear early in April, the last of June, and the last of August. In New England and the adjoining region, the first brood usually appears during the last week of May, or in the northern half of the district the first week in June, or occasionally the very last days of May. It becomes abundant in about a week, when the first females appear, begins to grow less common after the middle of June, and usually disappears shortly after the first of July, although in northern or elevated localities it may continue in scanty numbers until the middle of

July. The female deposits her eggs in the latter half of June (perhaps earlier) and early in July. The change to chrysalis from the resulting caterpillars occurs during July, the chrysalis hangs two or three weeks, according to latitude and season, and the butterflies appear again in the middle of July, often while those of the previous brood are still flying. Some chrysalids continue to disclose the butterfly throughout this month, but the latest probably remain unchanged until the following spring, and the spring butterflies are the united product of both the broods of the previous year; the numerical inferiority of the second brood renders this probable, and it has been shown by experiment to be the case even in West Virginia. The eggs of the second brood are doubtless laid in the latter part of July and early in August, and the caterpillars from them become fully grown between the middle of August and the middle of September, by which time all are in chrysalis.

The egg is nearly globular, smooth, and leaf-green, and is laid singly upon the upper surface of the leaf on small trees, on the branch nearest the ground, and generally only one egg can be found on a tree; the eggs usually hatch in eight days, but I have known them to last a fortnight. They are very liable to attack by parasites so small that sixteen or more may hatch from a single egg. Such parasitized eggs may be quickly recognized by their inky blackness.

The infantile caterpillar just from the egg has a black head, and a dark body slightly swollen in front, having a broad, oblique, saddle-like, greenish-white band across the middle, and armed with a few longitudinal rows of aculiferous tubercles. The mature caterpillar has a wholly different aspect; it is naked and smooth, of a leaf-green color, with a reddish head, the front part of the body much enlarged, and bearing a double stripe of yellow and black across its back, and ornamented besides in front of this with a pair of ocellate spots of yellow-black and turquoise, and behind it with several rows of turquoise dots.

The caterpillar is one of the most polyphagous in our country, feeding upon plants of a dozen different families of angiospermous plants; birch and poplar appear to be the favorites in New England, Liriodendron in the middle States, and the different species of ash in the south. When young it bites deep excavations out of the edge of the leaf opposite the spot where it rests, weaving a bit of carpet on another part of the leaf, to which it retires when not feeding; resting here, it arches its body as if impatient to assume the swollen form of the front part of the body, which belongs in a higher degree to its maturer life. As soon as it has once moulted, sometimes before moulting, it moves to a fresh leaf and there weaves a new carpet, generally in the middle, but if the leaf does not droop so as to enable it to rest on this spot in a vertical or nearly vertical position, it chooses instead a vertical part of the leaf and rests here, head upward, so that all excrement falls to the ground and the carpet remains clean. It feeds both by day and by night, but it does not now eat the leaf it rests on, but goes off every few hours for a dinner on another leaf, and, indeed, on the same leaf it has dined on before, always finishing one before attacking another.

Soon after it has reached its fourth stage it changes its method of laying its carpet, and it does so only just before that remarkable change in its appearance occurs by which it assumes the adult color and form. Being about to put on the *toga virilis*, it must needs set up a new establishment. The web or hammock now woven by the caterpillar, and upon which it rests, is scarcely at all attached to the middle line of the leaf as it was before, so that now its sleep is taken on a spring-bed, as it were. It is formed of interlacing threads, which lie to some extent across the leaf, few or none being longitudinal, though many are oblique. The carpet seems, however, to be closely attached to the leaf toward the stem and toward the apex of the leaf, but not quite so densely as at the sides, and the carpet has considerable thickness. It is so tightly stretched across the leaf that a section of the latter would represent a bow, the silk being the string. On this elastic bed the caterpillar reposes, the fore parts of the body being drawn in so as to still more swell out that part on which the colored spots are conspicuous.

Although the caterpillar has a general resemblance to that of the Green-clouded Swallowtail, the chrysalis is very different from that of this species, resembling rather that of the Black Swallowtail, whose caterpillar that of the present species in no way closely resembles. The chrysalis of the Tiger Swallowtail is straight and not bent, rugged and rough, with little jagged prominences, and resembles a rough bit of bark, which its gray-brown color intensifies.

The fondness of the butterflies for flowers has already been noted, and also their taste for decaying animal matter; their tastes, indeed, range from that fondness for nectar which the poets praise as godlike, down to that of the ordure of animals, engaged in extracting the juices from which it may be readily captured. Their tameness is perhaps a corollary of their congregating propensities; unless frightened by some attack upon them, when assembled they will allow a very near approach with apparent unconcern. When a flock feeding at a puddle in the road is disturbed by a passing wagon, the butterflies afterwards hover about the spot, alighting and arising again, and flying backward and forward and around the spot for some minutes before all have settled again; apparently each has to be adjusted to its neighbor, and the advent of a new claimant for place may for several times disturb all the rest, and the business of alighting recommence.

The flight of all our Swallowtails is nearly the same, but this butterfly is perhaps peculiar for its sailing and soaring; it flies high and low, rising and falling alternately several feet at a time, usually moving at about twenty feet from the ground; it flutters in and out among the branches of a tree from base to crown; or, meeting a dwelling in its flight, mounts upward, soaring high above it rather than turn in its course. It has a wayward flight, and in battling against the wind, it beats the air pretty vigorously, yet not so rapidly as butterflies with shorter wings. Startled, it flaps its wings with intense vigor, darts from one side to the other with fatiguing irregularity, nor stops until far out of sight; yet when settled on its favorite flowers, such as the lilac, it may be approached and readily taken with the hand.

ERYNNIS SASSACUS — THE INDIAN HESPERID

Of this tawny little Skipper very little can be said. It is an insignificant insect, expanding less than an inch and a half, with the markings mostly rather obscure. It is tawny above, heavily bordered with dark brown, greenish-buff below, with faint markings; the male has in the middle of the fore wings, above, a slightly arcuate, slender, velvety black streak, tapering at each end. Its known distribution is probably much less extended than its real range, for it is too irregular to be altogether natural. It is found from Massachusetts to Georgia, along the Appalachian chain, and in a narrow belt above the fortieth parallel from the Atlantic to Colorado. In New England it has been rarely found in northern districts, the only localities known being Norway, Hallowell, and Brunswick, Me., and southern New Hampshire to the edge of the White Mountains. It undoubtedly occurs in Vermont, though not reported from there, for it is found in every part of Massachusetts from the lowest to the highest stations, and has been reported from near Albany, N. Y.

The butterfly is single-brooded in the north, double-brooded in the south, probably passing the winter as a chrysalis. In Georgia, the butterfly appears by the middle of April, and again, after ten days in chrysalis, at the end of August. In New England, it is one of the earliest of the smaller Skippers, the earliest butterflies being seen during the last week in May, the female scarcely later than the male; sometimes they are not seen before the middle or latter part of the first week of June, but they are generally out by this time in the northernmost limit of their range, and they evidently continue to emerge from the chrysalis until the middle of the month, and continue on the wing throughout this month; sometimes battered individuals may be found until the middle of July. The female begins to lay eggs by about the 10th of June. The after-history is little known, except that it is very long drawn out.

The eggs are pretty large, with a very broad base, high and well arched, chalky white when laid, turning dirty yellow, the shell thick and hardly showing, even with a strong hand-lens, the reticulation with which it is covered; they are laid singly on grasses, and hatch in from twelve to fifteen days. The caterpillar is sluggish at the beginning of its life, as afterward. It takes it from twelve to eighteen hours to effect its escape from the egg, and it remains nearly a fortnight in its first stage, before moulting. In this stage it gets between the blades of grass, close down to their union with the stem, and uses this mere crevice for a nest, apparently without any silken fastenings. Its habits, unlike most Skippers, are not specially cleanly, for it soils its own nest considerably. In this stage it has a large, dark head and collar, and a plump, white body adorned with several rows of small mushroom-shaped appendages, and the last segment with half a dozen upcurved bristles about as long as the height of the body. The mature caterpillar and chrysalis are unknown. The butterflies are rapid in flight, and are abundant in grassy fields and meadows, loving the hottest rays of the sun.

A word may be added regarding the discal streak that has been mentioned as found on the fore wing of the male butterfly. As a general rule, the androconia or peculiar scales of the male are concealed in some way, perhaps to conserve their odoriferous qualities, and this is nowhere more clearly the case than in the larger Skippers, where they are completely hidden in the reflexed margin of the fore wings. But in the smaller Skippers, to which tribe this butterfly belongs, the matter is quite otherwise when androconia exist at all. Here it would seem as if an attempt at something specially conspicuous had been made, for we find patches or oblique dashes of peculiar scales covering veins and membrane indiscriminately, but usually, and in our native butterflies always, occupying the middle of the fore wing, and crossing the median veins obliquely near their base. These dashes are variously formed, but the scales which compose the most striking external feature are much larger than the ordinary scales, are black, and frequently partially erect; they may also differ in various parts of the patch itself, and may alter their character abruptly; for instance, some comparatively huge and brilliant scales may occupy the middle line, and be buttressed by a multitude of minute crowded lustreless scales; or there may be at one point a sort of whirlpool of large party-colored scales, imbricated in the most regular fashion like the normal scales, and beyond them again a multitude of the minute crowded lustreless scales. These peculiarities, however, must be studied with a glass; the naked eye may indeed discern that the patch always differs in the different species, but the general effect in all alike is a variously formed patch or oblique streak of black.

Now, however important it may possibly be as an ornamental appendage, the object of all this is primarily concealment for the androconia, which are quite out of sight, roofed in by the large imbricated scales on opposite sides of the patch, which it would seem the insect must have the power of parting to allow the scent to escape, just as the costal fold of the larger Skippers can be opened, flung open, probably, by some muscular movement at the base of the wing. In this discal patch there is also a certain regular distribution of the special scales, and these have their characteristic types.

ATRYTONE ZABULON — THE MORMON

Appearing at about the same time as the last, the present Skipper (Plate VI., Fig. 1), slightly larger than it, is better known. It is tawny above, broadly bordered outwardly with dark brown, often heavily infuscated next the base, the fore wings with a blackish dash just beyond the cell, the male not distinguished by a discal patch; beneath, the color is nearly uniform but less vivid, or the outer border is margined as above; the hind wing is dark, with a large central tawny patch. Two forms of female occur (whence the vulgar name), one of which is scarcely distinguishable from the male, the other infuscated or melanic throughout, with very feebly indicated markings.

We have several instances of this melanism among our butterflies, always confined to a single sex, and usually to the female; one remarkable case has already been mentioned recently in discussing the Tiger Swallowtail, where it is dependent upon latitude, which appears to be the case in nearly all, perhaps actually in all, instances. I have discussed this phenomenon at some length in my "Butterflies of the Eastern United States and Canada," and will not enlarge upon it here further than to say that melanism appears to prevail south of the latitude of New York, and its opposite, albinism, north of the same.

This butterfly is found throughout the northern United States east of the Great Plains, and follows the Alleghanies southward to Georgia. It is also found in the settled parts of Canada from Nova Scotia to western Ontario, and even to Alberta, and in the United States has been recorded even from Colorado and New Mexico. It seems to occur in every part of New England. The dark form of the female, however, is not known to have so wide a range, being absent from most northern localities; in New England it is not known from the northern half except at Portland, Me., and it has never been reported from Nova Scotia or Quebec; the most northern stations known are Montreal, Ottawa, and London, and it certainly appears to increase in abundance southwardly.

The insect is single-brooded, at least in the northern half of its range, passing the winter sometimes as a full-grown caterpillar, sometimes as a chrysalis. The first butterflies make their advent in the latitude of Boston during the last week of May, usually about the 27th, but sometimes by the 22d, in the White Mountains during the first week of June. In southern New England it appears nearly a week earlier than about Boston, the female, even, being sometimes taken as early as the middle of the month. In the early part of June it is exceedingly abundant, and the dark females usually appear about this time, though they may occasionally be seen as early as the normal type; by the middle of June most individuals captured at large about Boston will have abraded wings, and during the latter half of the month the insects diminish in numbers rapidly, sometimes disappearing entirely by the 25th, though they often remain on the wing until the end of the first week of July, or a trifle later.

In the northern parts of New England, and in Canada, it may usually be found even later than this; while on the other hand it has been reported in Georgia as early as April 26. Whether this indicates a second brood there, it is impossible to say without further data, but it has once been reported about Boston early in August, and I have seen a male taken in Iowa on August 12, showing either that occasional early chrysalids give forth their inmates the same year, or, what is far more probable, for the caterpillars are extremely lazy, some individuals are occasionally greatly belated. To return to our history: The female begins to lay eggs early in June, being busiest about the middle of the month, and continues the operation until it disappears. The eggs hatch in from eleven to thirteen days. The caterpillar may be found throughout July and August, for it is not until September that it is full grown and passes into the chrysalis; some, indeed, are still feeding at the end of September, and then pass into hibernation without changing to chrysalis.

The eggs are laid freely in confinement on grasses and singly; they are nearly hemispherical, large, a little flattened at summit, and greenish-white, without sculpture. The caterpillars just from the egg are white, with a large black head, a narrow black plate behind the head, the body pale and tinged behind with yellow, having longitudinal rows of short, scarcely expanded bristles, and on the last segment two pairs of very long, recurved, tapering bristles, besides four at the edge directed backward. When full grown they are fat, cylindrical, naked creatures, tapering at either end, with a ferruginous head of no great size, and a speckled, brownish body.

The caterpillar, on escaping from the egg, devours first the little circlet of cells at the summit of the egg, and in one instance observed by me, the creature then remained four days longer in the shell before making a hole large enough to escape! It is always a long time in making its exit, for as another instance may be mentioned one which, twenty-four hours after it had eaten a hole nearly as large as its head, was still curled up in the egg, though it had now devoured about two thirds of it; another, which was observed to have merely taken three or four bites early one afternoon, on the next morning had only completed a hole as large as its head; in this last instance, however, every fragment of the walls had disappeared in another hour.

The caterpillar feeds upon common grasses, stationing itself about the inside of the blades near the joints, drawing portions of the blades together by silken cords, thus forming a rude shelter. When placed on a strong-ribbed blade, the edges of which when young it cannot bend, it spins a few threads at short intervals from rib to rib, and places itself behind the strands. This action is performed by carrying a thread repeatedly between the same points, each thread being drawn tightly and made a little shorter than the previous, until the edges are brought so near together that the caterpillar has only room to withdraw its head; the process is very slow, but is carried on without cessation until completed; one of the little strands is composed of twenty or thirty threads. If at all disturbed, it at once makes a new nest, which, as it is always very slight, is no very difficult task. It is extremely deliberate in all its movements, remains quietly in its nest by day, and ranges the neighborhood for food by night. When about to change its skin, it forsakes its nest, and, crawling downward, conceals itself, generally head downward, among the stems and roots of the plant; it also invariably leaves its nest to expel its excrement, being very cleanly in its habits like most other Skippers, in marked contrast to the caterpillars of some of the higher butterflies.

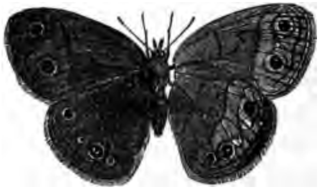
When about to change to chrysalis, the caterpillar constructs a nest of growing grass blades, generally near the joints, similar to its former habitation; continuing its work, however, it closes all the interstices and even the upper extremity of the nest (which previously, in the vertical nests it always makes, is invariably left open for exit) with a fine web of whitish silk, in which is rather profusely intermingled minute bunches of flossy silk of the same color, making a barrier impenetrable to the sight. Within this vertical cocoon the transformation soon takes place; so far as I have seen, no girth is made around the middle of the body, and the hooks of the tail-piece are simply plunged into the silk at the bottom of the cocoon. The chrysalids are slender and rounded, light brown in color, and covered all over with a whitish bloom; the tongue-case extends some distance beyond the wings, and is there free.

The butterflies may be found nearly anywhere in the open country, apparently preferring meadows, and are very fond of the juices of flowers, the butterfly weed being especially attractive to them. They are brisk, active flyers, off at a bound with wave-like starts, and then alighting as abruptly under your eye, as who should say, "Here I am; what's up?" They rarely rise to more than a couple of feet above the ground, but go swaying vigorously up the road as you advance toward them. When alighted, the wings are all held alike, a little divergent from the vertical; but when at complete rest, they are completely closed and the fore wings tucked between the hind pair, while the body is raised high upon the legs.

CISSIA EURYTUS — THE LITTLE WOOD-SATYR

THIS shade-loving butterfly is the first of our Satyrids or Meadow Browns to appear upon the wing, and one of the smaller forms. It is of a nearly uniform dark brown, the outer margin of the wings delicately penciled with darker lines, the upper surface furnished near the margin with rather large dark ocellated spots, which are repeated beneath, and their number increased by other smaller spots, forming a regular series; the middle of the under surface is further crossed by a pair of distant, parallel, nearly straight dark lines.

It is almost exclusively confined to the portion of the United States east of the Great Plains, and nearly everywhere is spoken of as abundant. It occurs all along the Atlantic coast, even to southern Florida, and is recorded from Alabama and Texas; it is profusely abundant in Iowa, occurs also rarely in eastern Kansas, is reported from Nebraska, and is common in Wisconsin. North of our border it has been taken about Quebec, Montreal, Ottawa, Essex County, Ont., and at Sudbury, north of Georgian Bay. In New England it is found in all the southern and middle portions, but is absent from or rare in the northern. The most northern points known to me are Walpole, Plymouth, and Milford, N. H., Norway, Brunswick, and Portland, Me. It does not occur in the White Mountain district proper, but will probably be found close to its southern boundaries and quite as far north in Vermont, as it has been taken in the Adirondacks of New York. In the southern part of New England it is exceedingly abundant.



It frequents tall thickets and groves, the borders of open woods, and partially shaded forest roads. It has a dancing flight, skipping here and there with a careless grace and ceaseless movement about three or four feet above the ground, disappearing among the foliage and anon reappearing, so that one loves to stand in the quiet wood, watch its fanciful movements, and dream that fairies float on butterfly wings. It walks, as it flies, by a succession of spasmodic little starts.

The eggs are laid singly on blades of grass, living or dead. Of fourteen laid in confinement, only five were laid on living blades, the remainder on dead blades close to the ground; they are slightly attached to living blades at indifferent heights above the ground, the smaller blades being apparently preferred. They are subglobular, covered with delicate reticulation, and very pale green.

The caterpillars feed on grasses. When just from the egg, they have a large, greenish head, knobbed above, and a cylindrical, pale brown body, with several longitudinal series of long, erect bristles, knobbed at the tip. When full grown, they have a very different appearance, having a rounded, gray head, and a brown body tapering at either extremity, striped with pale and darker green, the last segment furnished with not very long but sharply conical horns directed backward, which are wanting when born; the body is covered with short, dense pile.

When young, they eat only the edges of blades of grass and move about but little, a habit which seems universal among the Satyrids. When larger, they frequently bite off whole blades of grass above themselves and feed from the end of the standing blade; marks of their feeding are seen in the scattered tips lying on the ground; they feed mostly by night, lying concealed by day among the roots of the grass, sometimes on dead sticks, which they much resemble: they are shy, usually dropping to the ground on the least disturbance; they eat meagrely and therefore grow slowly, only attaining the length of half an inch before cold weather, when they seek a hiding-place and sleep through the long winter.

In Mr. Edwards's experiences in West Virginia he found the earlier stages rapidly passed, but the last very much prolonged, with periods of lethargy in the latter half of its life. I have, however, always found the caterpillar sluggish at all times in New England; while the first moult was passed in West Virginia in a week, the first stage lasted more than two weeks in Massachusetts, and in three weeks thereafter the third moult was passed; the fourth stage, however, is always very much prolonged, being generally fully three weeks in duration. During the first and second stages it feeds both by day and by night, resting after feeding wherever it happens to be, extending its body along the blade of the leaf, head upward or head downward, and when feeding, nibbles only the edges of the blade. Its movements are astonishingly slow, almost as difficult to see as the motion of the minute hand of a clock. After the second stage is passed, it feeds only by night, and rests only on the stems, not on the blades, retiring usually to the very foot of the stalk, and pushing its way headforemost as far as it can go down to the base of one of the blades, turning back to feed again toward sundown. In resting, the caudal horns are nearly horizontal, but a trifle raised.

One which was overtaken by winter, after it ceased to eat wandered slowly for several weeks — though remaining motionless most of the time — in the search for a suitable place to hibernate; finally, early in November it took up a position near the base of a bundle of leaf stalks, where a dead blade from another cluster overhung it, spun a single thread across to unite the two, and stationed itself head upward for the winter. Another took up its station on the base of a blade of grass about October 20, and remained here, in the living-room of a house, until January 26, when it aroused and began regularly to eat by night, and to hide as above described by day.

Preparing for pupation, the caterpillar spins a web on a blade of grass just where it has been feeding, or without wandering far, hangs by the tail in a very strongly curved position for three days before casting the larval skin, and then hangs as a chrysalis for about sixteen days in the north, eleven in the south. The chrysalis is pale brown, heavily flecked with darker brown, well rounded, but a little constricted in the middle, and with a pair of slight longitudinal ridges on the abdomen; the anterior extremity is abruptly docked.

There is only one brood annually. The butterfly appears in the extreme south of New England about the 20th of May; in the vicinity of Boston usually at the close of the month or the very first of June; it remains common throughout June, seldom much longer, but occasional specimens may be taken far into July, and I have taken it August 3. In Ontario it usually appears about the 10th or 12th of June, though sometimes as early as the first. Its ordinary appearance in New England can hardly be delayed until the second week in June, but it may be that it varies greatly, according to the season, for it is said to have appeared one season at Brunswick, Me., as late as June 23. In the extreme southern States it makes its appearance the last week of March, and continues through April into May.

The above account concerns principally the vicinity of Boston; but elsewhere, both north and south, fresh specimens have been taken much later in the season, and it is believed to be double-brooded in West Virginia. Fresh specimens of the male were taken one year in the hilly region of the Connecticut valley between the 6th and 10th of July, unaccompanied by females or by worn specimens, and for the next three days fresh specimens of both sexes. It has even been reported from Canada in September, and in West Virginia not only are fresh specimens seen in the autumn, but the butterfly has been reared there from eggs of the same season. This has also happened to me in Cambridge, Mass., but it was in the house, under protection, and the change to chrysalis did not occur until October 13, and so was quite abnormal.

The caterpillar is, however, so very sluggish in its movements, and, under favorable environment, with plenty of fresh food and protection from the inclemency of the weather, takes so long to undergo its changes, normally hibernating in New England in the last larval stage, that it seems quite impossible that the fresh July butterflies found in the Connecticut valley could have come from eggs of the same season. It seems rather more probable that some caterpillars, overtaken by the cold season in their penultimate or even a preceding stage, reached their development at a correspondingly later period the following year; but why these should appear after their more steady companions had had their season and disappeared is a question to be yet solved. It would seem as if this July brood were an accidental offshoot, trying to perpetuate itself, and by the necessities of the case breeding in and in, and taking, like the alternate brood, an entire year for the completion of its cycle.

The normal continuance of the species in New England after the flight of the May-June butterflies is as follows: The butterfly lays its eggs in the latter half of June, and they hatch in thirteen days (eight days in the south). The caterpillar grows slowly to at least its penultimate stage, and often nearly to maturity, before hibernation, feeds more or less in early spring, and changes to chrysalis in May, when the butterflies appear again.

Stability and instability are curiously mixed in the lives of butterflies. Observing the habits of certain kinds, one would suppose they were sensitive to the least influence from outside, scenting, as it were, the approach of winter from afar, and making early provision for it. Winter, indeed, is the prime cause of variety in the lives of animals, and hence we find in this particular much more variety in temperate regions than in the tropics. On the other hand there are kinds — and they are pretty numerous — which act as if they had never heard of winter. This is particularly so with plural-brooded butterflies; for in their case it is a common thing to find every possible stage on the ground as winter comes on; the more the number of broods is multiplied, the more confused do the distinctions between the broods become; and in many cases, were the season longer, no doubt it would be impossible to trace them, as sometimes in the tropics. The butterflies go on sucking honey and laying eggs, the eggs hatching, the caterpillars eating, until a heavy frost kills off the unprepared and terminates the history for the season; those of one stage survive the shock, the others die; this is the case with several of our Swallowtails and yellow butterflies, and with not a few others; in such cases, it is sometimes the caterpillar, sometimes the chrysalis, at others the butterfly, which survives; the egg, I believe, never.

Winter, of course, intervenes to alter the mere duration of certain stages in alternate generations, as in the case of double-brooded butterflies which winter as caterpillars; here the wintering caterpillar suffers a torpidity of which the summer caterpillar knows nothing; yet in some instances the latter seems to be seized with a certain lethargy akin to hibernation, and even sometimes prolonged so as to become hibernation, the insect being in this case partly single and partly double brooded.

These irregularities give a piquancy to the study of the life histories of butterflies, for the unexpected is often happening, and even, as we have seen, individuals of the same brood do not all behave alike, but show a surprising individuality. It may thus happen that two observers following the life history of the same insect may reach very different conclusions; for as the season, and especially winter and its adjuncts, sudden and considerable changes of temperature, have much, or primarily all, to do with this complexity of life, so observers at different latitudes may need to complement each other's observations to learn the whole behavior of an insect; and comparative observations north and south are highly desirable whenever any such question arises. Nothing surprised me more than to find that most of the smaller Skippers, which I had found very commonly single-brooded at the north, were double or even triple brooded at the south; in the north they are such slow feeders that I naturally assumed that such were their habits everywhere; but observations in the south proved quite the contrary.

A very considerable number of double-brooded butterflies show some variation in the numbers of the different broods, uniformly, year after year. In all such cases something disturbs the regularity of habit or uniformity of life; the lives of some are prolonged, of others hastened at special stages; and these are the butterflies whose life histories require the most careful and searching observations, continued and repeated, and the study of which is fullest of interest and significance.

THYMELICUS MYSTIC — THE LONG-DASH

EARLY in June is the time for most of the smaller Skippers to appear, and among them one of the commonest in many places is a tawny butterfly, with a broad brown border to the fore wings and a dash of brown beyond the median cell, besides, in the male, a slender, slightly arcuate, discal dash of blackish scales; the hind wings are almost entirely brown, but have a tawny band crossing the wing beyond the middle. Beneath, the wings are buff or tawny, with the brighter markings of the upper surface vaguely repeated. It expands about an inch and a third.

The distribution of our smaller Skippers is less definitely known than that of most of our butterflies, for they have been less studied from their relative insignificance and slight distinction in general appearance. The present species probably occurs everywhere in our northern States east of the Mississippi River, although recorded from relatively few western localities. Southwardly it is found as far as Pennsylvania and Maryland; to the north it has been taken in Nova Scotia, along the lower St. Lawrence, and at Montreal and Ottawa. In the west it occurs in Illinois, Michigan, Wisconsin, and north of Lake Superior. It occurs everywhere in New England except possibly in some extreme southern portions, but it is less common in the south than in the north, and is rather rare in the vicinity of Boston.

The eggs are smooth, hemispherical, and very pale yellowish-green, and are laid singly on and, notwithstanding their broad base, attached very lightly to grass blades. They have been known to hatch in eight or nine days, but my experience has been that about Boston the period is generally ten or eleven days, and in the White Mountains usually about thirteen; while some eggs brought from Lake Superior to Boston took twelve to fourteen or more days to hatch.

The caterpillar is born with a large black head, and whitish body which has a black shield on the first segment, and on either side three rows of moderately long dermal appendages and some very long recurved hairs at the hinder extremity. When full grown it is long and slender, largest in the hinder half, of a dark color from densely scattered blackish dots, a narrow black thoracic shield, dark reddish deeply punctate head, and a very thin and excessively short pile. Its natural food preferences are not known, as it has only been followed in confinement, but it readily eats common grasses, and its habits are much like those of the caterpillar of the Mormon. It devours its forsaken egg as soon as hatched. It is timid, and retires abruptly at the least alarm to its tubular nest of grass blades, which is firmly constructed of many blades and many threads, some of the larger openings being covered with a gauze-like, rather open framework of silk. It is slow to mature, several weeks being passed, in my experience, in each larval stage, though one instance is known of its being carried from egg to chrysalis in about forty days. The chrysalis has never been described.

Too little is known of the life history of this butterfly to give it with any confidence. As far as New England is concerned, the indications are that it is double-brooded in the southern and single-brooded in the northern part. In the extreme south of this district, the first butterflies make their appearance in the earliest days of June, perhaps even in May; fresh specimens continue to emerge during the first half of June, but by the middle of the month their numbers begin to decrease, and they to appear rubbed and worn; they lay their eggs at least as early as this, and have disappeared by the end of the first week in July, usually before the end of June. The eggs are hatched in from eight to eleven days, but the caterpillars do not seem to be very uniform in their growth, some attaining full size only in October and passing the winter in this stage, others changing more rapidly and producing a second brood of butterflies, the earliest of which appear from the 7th to the 10th of July, laying their eggs within at least a fortnight afterwards, and continuing upon the wing until some time into September; the eggs are hatched in ten or eleven days; probably the caterpillars from them attain maturity before winter, but they may very likely vary in this respect. Whether the caterpillars that have wintered in the south ever feed in the spring is unknown.

Passing northward, the butterflies of the first brood do not seem to make their appearance in such elevated places as, for instance, the higher parts of Berkshire County, Mass., before the 10th or 12th of June, and it may be that here no second brood makes its appearance. Among the White Mountains or north of Lake Superior it is certain there can be but a single brood, for the butterfly does not make its appearance at all until the first week in July, a few days only before the advent of the second brood in southern New England with its longer season. Eggs in these northern parts are hatched in about thirteen days, and caterpillars go into hibernation in some instances, perhaps always, in their third stage, toward the end of September.

The butterfly frequents open, grassy fields, and like its fellows is very fond of flowers. Guignard tells how he found a lady's slipper (Cypripedium) in which this butterfly with two other Skippers almost entirely filled the great bowl to the lip. Its flight is quite like that of the rest of the tribe, and when it alights, the hind wings are placed horizontally on a single plane, while the fore pair are raised obliquely, giving it a disjointed appearance; when at complete rest, however, all the wings are tightly closed over its back. When alighted, but alert from some alarm, it moves one antenna forward and backward a little.

This method of holding the wings on alighting is very common to the whole tribe to which this butterfly belongs, and it is not a little curious to see how what seem like fanciful habits such as this run through a whole series of allied forms. The butterflies of the other tribe of Skippers do not act in this way, some even alighting with widespread wings; though it should be excepted that, when alighted on flowers, nearly all butterflies do so with completely raised wings, either not wishing to be hustled by others coming on the same errand, or unselfishly (!) wishing to block no one's equal enjoyment. The reason, however, for the peculiar attitude assumed by the smaller Skippers is difficult to discern. Equally difficult is it to understand the reason for another habit peculiar to and very common among the little Lycænids, that of never resting just where they alight, but sidling around to a new posture, — perhaps with regard to the direction of the sun, — and then moving the erect hind wings up and down alternately on the two sides, making them appear like discs revolving in opposite ways. But there are plenty of other habits and tricks of movement among butterflies that are not at all understood. Observers out of doors are much needed.

EPARGYREUS TITYRUS — THE SILVER-SPOTTED HESPERID

THIS is the only American insect which attracted the special attention of Agassiz. Using its transformations as a basis, he has written a somewhat remarkable essay on the classification of insects. No one who has seen it alive would ever forget it, alike on account of its active movements and its striking markings. It is one of the largest of our Skippers (Plate IX., Fig. 2), with dark brown wings, the front pair furnished with yellow vitreous irregular markings, mostly arranged in a band across the middle, while the hind pair are adorned beneath with a very large pure silvery white spot of irregular shape crossing the middle of the wing, and have the anal angle prolonged into an obtuse rounded lobe.

It has a wide distribution in our country, especially in the south, where it extends from Atlantic to Pacific and southward throughout Mexico. In southern California and Arizona it is said to be one of the commonest butterflies found in that region. Northward it is found on the Pacific coast at least to San Francisco, but it does not seem to occupy the elevated central plateau of the country to the eastward except at its southern extremities, as in Arizona, southern Utah, and Colorado; east of the Rockies, however, it extends northward to Nebraska and Dakota, though east of this it begins to be uncommon along our northern tier of States, where we hear of it as tolerably common in one place but rare in another, the latter, for instance, in London, Ont., where there have long been excellent collectors. It has been found, however, at Ottawa and Montreal, and even at Quebec, though never yet reported from the eastern provinces. In New England it is common enough in the south, but very rarely reported from the north, few or single specimens only having been taken as far north as Norway, Me., and Plymouth, N. H.

The eggs are laid singly on the upper surface of leaves of plants, and are domed, heavily ribbed and cross-lined, and of a leaf-green color. They hatch in about four days. The little caterpillar when born is of a different shape from what it will become, being largest in front, with a still larger head, and tapering regularly, the body supplied with several rows of short club-shaped bristles, but otherwise naked; the head is black and uniform, the body pale greenish-yellow. When fully grown it has a very large ferruginous head, which seems all the more out of proportion to the body from the strangulated neck toward which the body tapers from the middle; it has two great orange spots like monstrous eyes on either side of the head, and the briefly pilose body is lemon-green transversely banded with darker green; it attains the length of an inch and a half.

It feeds on a great variety of leguminous plants of the papilionaceous division, especially on Robinia and Desmodium, but it has also been bred and the eggs found on hickory. When it is very young, and until it has arrived at its third stage, the caterpillar constructs a nest by nearly severing from one side of the leaf a small roundish piece and folding it over so that the under surface of the fragment is uppermost. This roof is kept in place by long silken strands attached to the edges of the fragment and the surface of the leaf beyond in such a way as to arch the roof like a dome. This must require considerable skill, for the pieces cut in this way are irregular in form and size, and stand at a considerable height, sometimes a quarter of an inch above the leaf. When older the caterpillars attach two leaves in a similar manner, one over the other, fluting the edges by attaching silken cords at short distances, so as to dome the upper leaf considerably. In this way they form a leafy case to shelter and screen them, from out of one more open end of which they crawl at night to feed. They are cleanly in their habits, coming out of their nest to eject their excrement, which they do with a snap which sends it to a considerable distance, often several yards. When disturbed, they move their head from side to side with angry spasmodic starts, their black jaws widely extended and snapping at everything with which they may come in contact. After moulting, they devour all the cast-off skin but the head.

In a single night, one nearly full-fed caterpillar in confinement, removed from its nest and placed among fresh leaves, spun silk over a dozen or more leaves, apparently in a vain effort to construct a nest, and extended threads from one point to another, one of which was an inch and a quarter long and very strong; but besides all this work, it ate large pieces out of several leaves, devouring even the ribs, — in all a quantity equal to two leaflets of the common locust.

Harris tells us that "they frequently transform to chrysalis within the same leaves which have served them for a habitation, but more often quit the trees and construct in some secure place a cocoon of leaves or fragments of stubble, the interior of which is lined with a loose web of silk." Specimens reared in captivity made their cocoons by drawing together leaves of locust so as to form a smooth oval cavity within; the whole interior was lined with a thin web of silk; within this cavity the creature spun two Y-shaped threads, whereon the chrysalis was eventually suspended; at the junction of the threads of one, the hooks at the tail of the chrysalis were plunged securely; on the other Y, the middle of the thorax of the chrysalis rested, on its back. The cocoon is sometimes made of very curious substances, earth or sawdust or little chips forming a part or the whole of its construction, apparently such first available material as the hurrying caterpillar may have found on its descent from the tree in search of a suitable retreat. The chrysalis itself is usually of a uniform chestnut color, plump and rounded, with a short abdomen, but may be marked more or less with black and testaceous.

This butterfly is single-brooded in the north, double-brooded in the south, and everywhere hibernates in the chrysalis stage. In the south the butterflies first appear in the latter part of March, and continue to emerge from the wintering chrysalids for at least a month, and to fly for certainly a month longer; the members of the second brood are consequently emerging from chrysalids from the middle of June probably until the middle of August, and they continue on the wing until at least the end of September. In the north the butterflies usually make their appearance during the first week in June, but not unfrequently as early as the 22d or 24th of May, even toward the northern limits of its range; they usually become abundant by the middle of June, and continue to emerge from the chrysalis until the very end of the month, although by this time they ordinarily become uncommon in the southern parts of New England; they continue, however, to fly until the end of July or the first week of August. The eggs are first laid about the middle of June, sometimes by the end of the first week, and the females are still ovipositing at the middle of July and undoubtedly until August; the fully grown caterpillars may be found between the middle of July and the end of September, when the last have gone into winter quarters and changed into chrysalis. It is possible that in southern New England there may be a small second brood, regularly or occasionally; and quite possible that there are three rather than two broods in the far south.

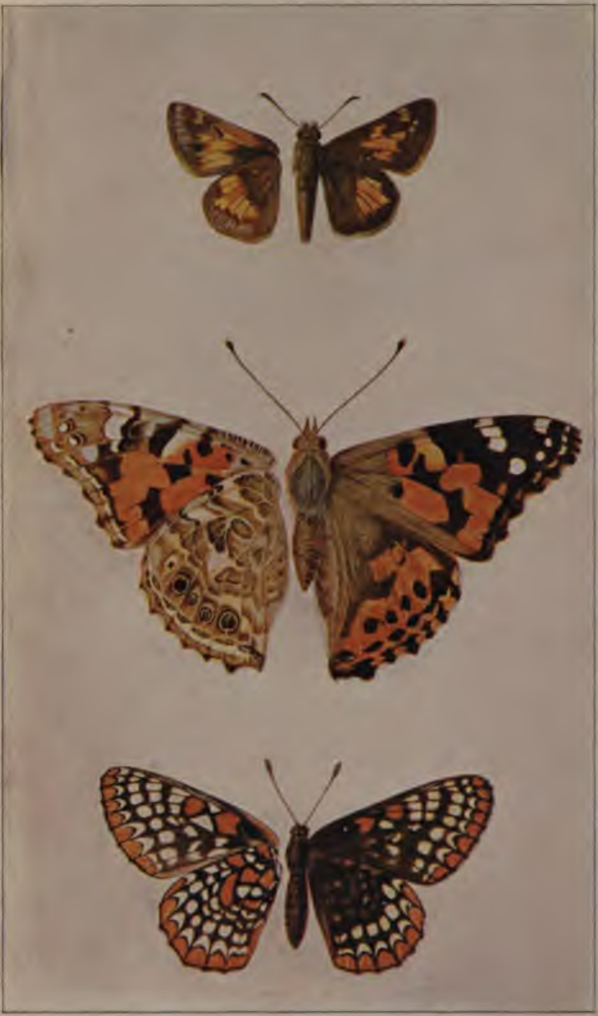
The butterfly may commonly be found about gardens, where it is attracted at midday by flowers. Lilacs, prince's feather, butterfly weed, and salvia have been mentioned among its favorites, and it has been caught in a cypripedium. Were it not for its propensity for flowers, it would be difficult to capture, for it is the most vigorous of our butterflies. It has a dashing, impetuous flight, starting with a plunge and stopping as abruptly; it startles the collector by its sudden advent, bewilders him by its unexpected dashes, and then vanishes like a swift but erratic arrow. When two of them meet, they circle around each other with amazing celerity, keeping always one or two feet from each other; suddenly one darts away in one direction and the other whisks off in another. It is also a pugnacious creature, attacking with rude vigor any insect, especially of a large size, which may seek to share with it the flowers it delights in. Gosse tells how he reared some of these butterflies in a dark box and attempted to open the lid to see if they were hatched. "Before the lid was half raised, all was scuffle and flutter within; . . . before I could catch a glimpse of anything within, one dashed out like lightning, and if I had not shut the box, the other would have followed as quickly." On ac-

PLATE VI

1. *Atrytone zabulon*

2. *Vanessa cardui*

3. *Euphydryas phaeton*



EUPHYDRYAS PHAETON — THE BALTIMORE

SOME butterflies roam everywhere on free wing; some seem inclined to a wayside life; and butterflies of these two classes are tolerably well known to every one. Others confine themselves to more or less secluded spots, and of these none are more strikingly local and little known than those which attach themselves to swamps. Of such is the Baltimore (Plate VI., Fig. 3), which may sometimes occur abundantly in a bog of a few acres only in extent, and be sought in vain outside its boundaries.

The butterfly is of medium size, the wings somewhat elongated with rounded margins, nearly black on both surfaces, with a rather broad reddish margin preceded by pale yellow lunules; between these last and the middle of the wing is a double or treble curving row of small pale yellow spots, while the base of the wings, especially beneath, is marked by a rather confused mass of reddish and pale yellow irregular spots.

It is found in isolated spots, and irregularly over all the northern United States east of the Great Plains, and in the bordering parts of Canada. It extends southward at least as far as West Virginia and Kentucky, and eastward to Nova Scotia and

New Brunswick, but how far north is not known. It occurs only in bogs or moist and shady meadows seldom visited by the entomologist, and is often so limited in range as scarcely to be seen a few hundred yards from a spot where it swarms. One might be a collector of butterflies for years and consider this butterfly one of the rarest of its tribe, and finally discover multitudes sporting in security a few rods from his beaten track. Its flight is rather slow and heavy, ordinarily about two feet from the ground. It is fond of alighting to suck the juices of red clover and whiteweed blossoms, but prefers generally to settle on the leaves of shrubs or of ferns, or even the ground. It is perhaps our most sluggish butterfly, and in keeping therewith is believed to be free from bird attack, and in a sullen, passive way it is hard to kill.

The eggs are subglobular, but largest below the middle and tapering above to a very broad and depressed saucer-like summit, the upper half ornamented with slight and frequent vertical ribs; when first laid they are yellow, but turn to a purplish color. They are laid in large irregular close clusters, several layers deep, upon the under surface of leaves, the clusters containing anywhere from one to four hundred eggs. A number of other butterflies are known to lay eggs in clusters, but none where they are so large or so heaped as here. They hatch in about twenty days.

The caterpillars when first hatched have five pairs of longitudinal rows, three above and two below the spiracles, of small warts, each bearing a rather short simple hair. When full grown they are rather stout, tapering a little at the front, and the body furnished with stout, tapering, blunt spines, each supplied with many aculiferous, conical wartlets, and arranged in five rows above the spiracles and two on each side below them; the body is dark orange transversely ringed with black lines. The principal food of the caterpillar, at least when young, is the snakehead, *Chelone glabra*, but it feeds also on other scrophulariaceous plants, and when past middle life, on Lonicera and other caprifoliaceous plants.

The hatching caterpillar bites an opening around the summit of the egg, sometimes leaving the outer portion of the ribs for the last; the lid thus formed is thrust off, and the caterpillar, emerging, partially devours the deserted shell. It then moves briskly about with its companions, and before eating any of the leaf, they prepare a small web upon its under surface; this web is very thin and covers little more than a spot sufficiently large for feeding; beneath this they eat only the parenchyma of the leaf, and the opposite upper surface turns black in consequence. They feed in rows, those of each row simultaneously moving the head and front part of the body from side to side as they eat. They frequently wander uneasily and rapidly from the web, but always return again; this restless habit they retain through life, so that they may be found as often off as on their food-plant. After their first moult they eat holes in the side of the leaves, generally near the middle and always reaching the midrib. Before their first moult, however, and indeed within twenty-four hours of their birth, their manner of life changes: they no longer feed on an open web, but bend the leaf upon itself into a sort of knot, or construct a covering web, usually on the topmost leaves of the stem, and feed on the green leaves inclosed; as these are consumed, the web is extended down the stem, covering fresh leaves. As they grow they enlarge the web, all working for the common good. Especially as each moult approaches, all wanderers come home and the web is made tight, and into it they retire and pass the moult, which over, the web is extended again. If at any time the web is injured by storms, the caterpillars forthwith set at work repairing, and do not rest, whether it rains or shines, till the work is done. A few holes are left for ingress and egress. To this nest they retire for the night and for moulting, feeding only by day, when they extend the webs over new feeding-ground, though many are found wandering beyond its protection.

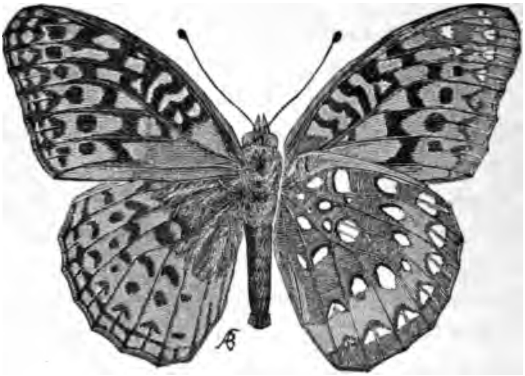
The first nests built are slight and quite transparent, the warp composed of long, regular, and colorless threads, which run from the stem to the middle of the next leaves below, and are bound together by innumerable cross-threads, which take no regularity whatever. Each succeeding nest is more securely built, till finally, when the third moult approaches, nine or ten days after the second, the web is often as large as a man's open hand, made of closely woven silk, of more than one coat, and capable of resisting storms and even the wear and tear of winter. As this season approaches, the leaves dry up and the whole mass contracts so that it may be no larger than a pigeon's egg. Opening one such nest, which was soft and flexible throughout, it was found very compact, formed upon the drooping head of the plant, which was partially distended, as it were, by the spring of the apical leaves; in various parts of the nest there were oblong holes or passages about the size of the caterpillars, and the interstices were pretty well filled with filth.

The caterpillars make some selection in constructing their nest, since they are not always found upon Chelone, which is an annual, and when using that as a basis, generally interweave the outlying parts of the surrounding herbage for its better support. Here, then, in this foul nest, they take up their winter quarters, in the north in the latter part of August, or early in September; but in the south about the middle of July, while there is abundant time for a second brood. Yet, whether in the White Mountains or in Virginia, to bed they go when the third moult is passed. Yet in Virginia, at least, their condition is not then properly one of torpidity, or even of lethargy, for when disturbed there is an immediate and general movement; some caterpillars then taken from their web and placed on a young plant of snakehead showed no disposition to eat or to construct another web; they ran over the new plant for some hours, and then betook themselves to the surrounding herbage; they evidently wished to be let alone.

In the spring all is changed. They forsake their web, and, though still gregarious to a limited extent, wander ceaselessly about, swarming over Lonicera and other plants, seeking only the concealment of dead leaves and the under surface of sticks on the ground in their moultings or during storms; but at other times always exposed to full view, when their brilliant color and active movements make them very conspicuous; neither do they seek protection by feeding at night; their only sensitiveness to danger is shown by the readiness with which they coil up and drop to the ground when the plant on which they are feeding is jarred.

The caterpillars wander vigorously for pupation, hurrying as if their lives depended on their reaching somewhere before the final change; yet somehow they do not seem thereby to disperse widely, for several may often be found hanging to the same bush or fence rail. They hang by the tail, are well rounded and rather elongated, with somewhat prominent wing-cases and many series of small conical tubercles arranged longitudinally; they are of a brownish-yellow color, spotted and blotched with black.

This butterfly is single-brooded everywhere. The hibernating caterpillars attain their growth in May, and the chrysalids hang for from fourteen to eighteen days. The earliest butterflies appear in the southernmost parts of New England at the very end of May or in the first days of June; about Boston they are seldom seen before the 12th of June, and they become abundant in a very few days after their first appearance, although they continue for some time to emerge from the chrysalis. In the White Mountain region they are not much later than about Boston, for I have found them in abundance on June 17. Toward the southern limit of their range they make their advent by the 18th or 19th of May. They are on the wing usually for about four weeks, and worn specimens may be found for a few days longer; by the 15th or 20th of July they have usually disappeared, even in the northern parts of New England. They appear to lay their eggs about three weeks after their first appearance, say between the 5th and 15th of July, in the latitude of Boston. These hatch in nineteen or twenty days, the caterpillars grow very slowly, and in their fourth stage, in the latter part of August or early in September, or in the White Mountains by the middle of August, begin to hibernate. They arouse with the first breath of spring, and in continued good weather, a week of feeding on the succulent leaves must be sufficient to mature them.



ARGYNNIS CYBELE — THE GREAT SPANGLED FRITILLARY

Among the butterflies that crowd the blossoms of thistles and milkweed, every one must have noted the great, fulvous, brown-spotted, round-winged species with large gleaming silvery spots on the under side of the hind wings. Three species occur in the east, and the largest of them, and the one most commonly seen except in the north, is the Great Spangled Fritillary. From its closest ally, the one nearest it in size, it differs mainly in the much greater width of the clear band between the two outer rows of silvery spots.

It belongs strictly to the Alleghanian fauna, rarely surpassing its limits in the east, but occurring more abundantly in its southern than in its northern half; so, too, it is apparently more common in the east than in the west, although it extends as far as Wisconsin and Missouri, and even Kansas, Nebraska, and the Dakotas, and in the northwest to Edmonton, on the Saskatchewan. The most southerly districts from which it has been reported are Virginia and West Virginia, where it is common, and attains a great size. It is comparatively rare in the northern part of the fauna, but it has been taken at many points along the southern border of Canada, and even at Cape Breton. In New England it occurs everywhere except in the White Mountain region and perhaps the district just north of it; but while it is exceedingly abundant in the southern portions, it is uncommon in the northern half.

It is found in open fields, sucking the juices of flowers, and is specially fond of thistles and milkweed. Its flight is somewhat rapid, strong, prolonged, frequently high, but usually at an elevation of from three to six feet, rather wandering, with sudden slight changes of course from side to side; it sometimes sails for short distances, with expanded immovable wings, often then descending slightly in broad circles. The wings are tightly closed when at rest.

The eggs are laid upon any part of the food-plant, or, in a few cases observed, are said to have been dropped by the hovering butterfly upon the ground over the food-plant, a very curious habit explainable by the life history only. The eggs are short, sugar-loaf shaped, honey-yellow, furnished with distinct, rather coarse, vertical ribs, sixteen to eighteen in number, and finer transverse raised lines between them.

The young caterpillar just from the egg has a black head and a dull olivaceous body, which is covered with little conical warts, ranged on each side in five longitudinal rows, each bearing at tip a long feebly clubbed bristle. When full grown the head is still black, but so is the body, and in parts velvety, and orange at the base of the spines, which have supplanted the warts, but have not taken exactly their place, for there are but three rows on either side, and they are long, black, and tapering, and beset with numerous bristles.

The food-plant is violets, any kind of which, native or cultivated, it will eat freely, and seems to show no preference. In escaping from the egg, the caterpillar sometimes devours nearly the whole shell before forsaking it; usually, however, it destroys only about half of it, and sometimes it merely bites a hole in the upper half just large enough to crawl through, and then leaves it. It is a very secretive caterpillar, lying in concealment most of the time, hurrying to its pasture when hunger compels, feeding voraciously, and then returning to its retreat. It is impatient of confinement, and therefore hard to rear in captivity. When about to pupate, it seeks the under surface of logs and stones or bark, and by placing bits of bark with the outer side uppermost in the vicinity of their feeding-grounds, one may sometimes secure the full-grown caterpillar by occasionally examining them.

The chrysalis is dark brown, creased and mottled with drab or reddish-brown, massive, somewhat angulate, constricted across the back, the ocellar tubercles only moderately prominent, the thorax keeled and arched, the wing-cases ample and protuberant, the back of the abdomen with lateral rows of rather prominent tubercles, some of them yellow at the base behind.

The insect is single-brooded in New England, passing the winter as a caterpillar just from the egg. As the food-plant is of no use to it until the spring, it is manifestly unimportant whether the eggs are laid upon it or dropped on the ground near by, for the plant itself dies down in the winter, and this explains any apparent anomaly in the mode of oviposition. Some European species are said to hibernate in the egg itself, which is practically the same thing; for, though our species eats at least a part of its shell in escaping before winter, not another morsel of food does it touch until spring. The caterpillar becomes full grown in June, the chrysalis hangs for from fourteen to twenty-four days, and the earliest butterflies appear in the latter part of June, sometimes as early as the 16th in the latitude of Boston, usually not much before the 21st, become common by the first of July, when the female first emerges, continue to escape from the chrysalis until at least the middle of July, and fly until the middle of September, and occasionally later. The butterflies generally pair at the end of July, but the eggs do not begin to assume their proper size in the abdomen of the female until about the middle of August, and are not laid until the last of August or first of September. The eggs generally hatch in about fifteen days, and the young caterpillars come forth into what must seem a cold, cold world.

In the south, say in Virginia, the life history is somewhat different; for, instead of an uninterrupted supply of butterflies fresh from the chrysalis from their first advent to shortly before egg-laying, the emergence is interrupted, and we have a semblance of two distinct broods, one early in June, the other after the middle of August, butterflies being rarely seen at all in July. I say *semblance* of two broods, because frequent dissection of female butterflies of the earlier period fails to reveal any eggs at all approaching maturity, and it is therefore apparent that the early butterflies are never the parents of the later, and that there is actually but one brood a year.

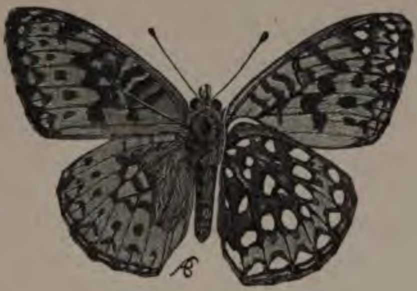
No such interrupted series of emergences has been detected in the history of the butterfly in the north, but it might, perhaps, be looked for successfully in the southern parts of New England. How this is brought about, or what is the cause of the long-continued uninterrupted emergence of fresh material from the chrysalis in the north, is unknown, and should be carefully investigated; but in view of the phenomena witnessed in allied butterflies, it seems altogether probable that it is the outcome of a certain degree of lethargy in the caterpillar (not yet observed), which would only need to be periodic and fixed in the south, casual and irregular in the north, to produce exactly the phenomena which we see. Whatever its cause, it seems to be a first step toward the establishment of a veritable spring brood in the south.

This curious difference in the period of the same butterfly in the north and in the south naturally suggests the inquiry: How long do butterflies live? There is, in fact, no little variety in this respect. When the disappearance of a given butterfly is in consequence of the approaching cold season, it may well be, and often is, the case that the butterfly has merely gone into winter quarters to appear again on the wing the ensuing spring. In such cases, the duration of life of a butterfly may be as long as eight or nine months, or even more, for there are hibernating butterflies which emerge from the chrysalis by the beginning of August or even in July, but which do not go into winter quarters until September, October, or even November, then appear again the next season as soon as advancing spring has begun to make itself felt, and continue upon the wing sometimes through June, sometimes even into July. It is impossible to say certainly whether or not the individuals flying latest in the spring number among them any which were earliest to escape from the chrysalis in the preceding season; but setting aside the chances of capture by their enemies, there is no reason to believe it impossible, and that they may spend, and probably in many instances do spend, fully ten months of the year in the winged condition.

This conclusion may also be reached in another way. We may add together the ordinary life period of the egg, the time it takes the caterpillar to reach maturity, and the duration of the chrysalis, and in these hibernating single-brooded butterflies we shall rarely find that these stages together occupy on the average more than two months. The remaining ten months must, therefore, be the average duration of the life of the butterfly itself. That many may live eleven months, or even twelve, seems probable, for a butterfly may continue to live for some time after the first eggs are laid, especially in the case of those which lay but one at a time, where the eggs do not develop in the ovaries at once, but slowly and by degrees, and so are deposited in succession over a considerable period of time.

It is possible that the duration of the life of butterflies is greater in the north than in the south. As one approaches the tropics, birds and other insectivorous creatures are far more destructive of butterfly life than with us, and the chance of long life upon the wing must be greatly lessened with the numerous liabilities to disaster which overtake the poor butterfly in the warmer regions. I believe there may be a difference in this respect even between districts so near each other as Virginia and New England. Certainly the conditions of life are materially different, and show themselves in the different behavior of many butterflies in the number of broods and their overlapping.

To judge from the statistics that I have collected from observations made in the field by many different persons, I am inclined to think that, in the case of those butterflies which are born and die the same season, the average length of life of the mass of them, that is, omitting mention of those which, cut off early, come to an untimely end, to be not far from four to five weeks, varying in different species from three to six or seven. Of course it is impossible to arrive at any very accurate determination regarding this, since in the case of any particular species we are obliged to base our conclusions on observations of the times when the earliest butterflies were seen, when they became most abundant, when the numbers perceptibly diminished, or specimens became old and worn, and when the last were seen. It is particularly difficult to decide upon the average age of individuals when, as is not infrequently the case, a brood of butterflies is augmented by gradual accretions for a long period of time, — three, four, or five weeks. It is again difficult in the case of those butterflies which, like many of the group to which the present species belongs, appear upon the wing in early summer, receive a sudden accession to their numbers a month or two after the advent of the others, and then only begin to lay their eggs. I, for one, can hardly believe that all these earliest individuals perish before the season for egg-laying, and from the condition of specimens, worse and worse as the season advances, I even think that some of the earliest live to the last, and are sometimes upon the wing for two and three months of the year.



ARGYNNIS ATLANTIS — THE MOUNTAIN SILVER-SPOT

LARGELY replacing the preceding species in the north and especially in Canada, and readily distinguished from it by its lesser size, generally darker coloring, and in the narrowness of the buff belt between the two outer rows of silvery spots on the under surface of the hind wings, is the Mountain Silver-spot. It is the prevailing Fritillary of the White Mountain region.

This characteristic member of the Canadian fauna is abundant throughout all the cooler parts of Canada, and in the east is very nearly limited southwardly by the annual isotherm of forty-five degrees, only surpassing it in elevated regions and along mountain chains. Northward it appears rarely to encroach upon what has been termed the Hudsonian fauna, but it has been reported from as far north as Fort Simpson, Rupert's Land, Hudson Bay, and central Labrador. I have myself taken it on Lake Winnipeg. It is common throughout all the district formerly known as Upper and Lower Canada, and occurs along the lower St. Lawrence and in Newfoundland, Cape Breton, and Nova Scotia. South of the British possessions and beyond New England it is found in the Adirondacks and Catskills of New York, in the higher parts of Pennsylvania, in Michigan, Minnesota, Wisconsin, and Iowa, and even in certain points in distant Colorado. In New England it is almost entirely confined to the northern half, the few places at which it is known in Massachusetts being in the Berkshire Hills and the hilly country bordering the Connecticut River.

The egg is very similar to that of the last species, but has only twelve to fourteen vertical ribs, and is a trifle smaller. The caterpillar and chrysalis are also very similar, the former differing principally in having a more purplish body with the base of all the spines pallid, and the latter being chestnut brown irrorate with black; chrysalids are attached to the under side of logs lying on the ground and in similar places.

The butterfly is single-brooded, the caterpillar hibernating as soon as hatched and without feeding. It undergoes its later transformations in the spring, probably awakening at an early period, as it feeds on violets, which are early in leaf. In the White Mountains, the butterfly appears about the middle or latter part of June, but does not become common until the close of the month. In the Catskills the males are said to appear early in

June. It is the earliest of the different species of Argynnis in any given locality. The butterfly continues abundant until the middle of August, and is still upon the wing in September. The eggs are laid during the latter part of August, when the numbers of the butterfly are beginning to lessen. I have opened the bodies of old and worn females at the White Mountains the middle of August, and found them only partially developed; four days later they were nearly ripe. The eggs hatch in a little more than a fortnight, and the caterpillars go immediately into winter quarters. The chrysalis in the spring hangs for nine days or more.

The favorite resorts of this butterfly are grassy fields skirting the mountain streams, and it differs slightly from other species of the genus in preferring sunny woodland nooks to open country. It may often be seen alighted upon offal or damp spots by the roadside. It closely resembles the other species in its flight, but is wilder and more difficult of capture. When it alights in the road, it rests with wings fully, flatly expanded; when on tree trunks with wings closed, head downward. The male follows the female closely, even long before oviposition. The female, when wearied with flight from its pertinacious mate, will rest with erect wings motionless upon the ground; its mate immediately takes position beside her, distant about half an inch or an inch on one side and behind her. The female in moving makes a quick start forward for a few steps; then the male does the same, and here, with wings erect, he keeps up a slight quivering agitation of the wings until his consort departs, when in an instant the winged pursuit is renewed.

I had often wondered at the meaning of this quivering movement of the wings by the male during courtship, when it suddenly occurred to me as highly probable that the object was to free and waft to the female the scent emitted by certain special fringed-tipped scales that occur concealed among the other scales along the veins of the upper side of the fore wings. One cannot handle this butterfly alive without observing a very perceptible odor from the male, which is often retained for months after death by specimens inclosed in papers, after the manner of the collector. I found it very difficult to determine what this odor was like; it seemed to be reminiscent of something in my experience, and at one time I fancied it had somewhat the fragrance of the pine woods; but on applying to Miss Soule, a New England entomologist, she at once said it was the odor of sandalwood, which exactly describes it. She added that specimens of the butterfly she had brought into her room at the mountain hotel made it seem close, and a friend who called inquired on entering: "Why! do you bring your sandalwood box up here?" The odor is apparently equally pronounced in fresh and in worn specimens, and arises, as I have said, from certain scales on the upper side of the fore wings.

Now the curious thing about it is that the male of the Great Spangled Fritillary we have just discussed has exactly similar fringed scales in exactly similar situations on the fore wings; they are so closely alike that they differ only in size and that to a very small degree; and yet they emit no odor at all, or none at least in any way perceptible to us. The same is the case with the Silver-spot Fritillary, which we shall take up later.

The only way to explain this apparent anomaly seems to me to be simply that our senses are at fault. For we have a whole series of known cases of odoriferous or aromatic butterflies,[1] in which the source has been traced to scales peculiar to the male sex, and these odors are presumably a means of attraction to the opposite sex; while a vast number of butterflies — I do not think it unsafe to say the greater proportion of them — possess in the male sex scales which are not found in the females, and which have therefore been called androconia. We further know, by direct experimentation and otherwise, that the odor sense is highly developed in insects generally, and especially in butterflies and moths, and the possibility of their perceiving odors imperceptible to our dull senses is very great. If then we find in two related butterflies organs of precisely the same character and developed in one sex only, for an apparently similar purpose, fed by similar glands, we must judge that the product of those glands is similar in the two cases, even though to us one is perceptible by its odor and the other is not.

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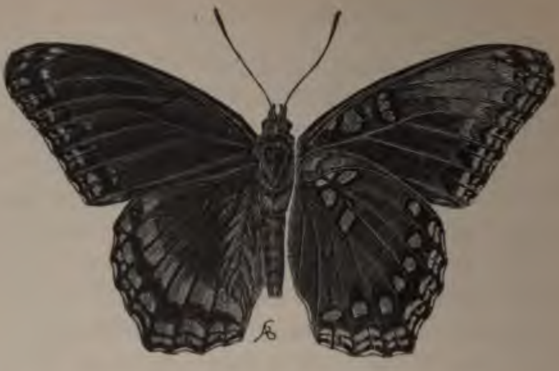
[1] See my *Frail Children of the Air*, p. 163.



BASILARCHIA ASTYANAX — THE RED-SPOTTED PURPLE

We come now to discuss, one after the other, a couple of butterflies belonging to a genus which is peculiarly North American, and one of the most interesting we possess. The eggs, in the first place, are very curious, being nearly globular, covered all over with high-walled hexagonal cells, from each angle of which arises a rather long and stiff tapering filament. The caterpillars when just hatched have a smooth head and a uniform cylindrical body, studded with numerous equal and similar stellate warts regularly disposed over the surface; when full grown, on the contrary, they are exceedingly grotesque in appearance and at the same time present a very threatening aspect; the head is surmounted by a pair of warty globular tubercles, and the forepart of the body is considerably hunched and tuberculated, while the whole body is so strangely and irregularly mottled with cream color and various shades of green as to add greatly to the fantastic effect. They are not only grotesque in appearance but in habit; they move about with little starts, very ludicrous to observe; they often rest, when sulking, with their front parts strongly arched, the front of the head resting on the leaf, the tips of the thoracic tubercles just touching the same, and the tail aloft; at other times they lean the side of the head on the leaf, or by the side of the stem on which they are resting, as if weary of this world. Then the chrysalids look as if just from a pot of paint, and are of an indescribable shape, having the front half of the body curved, the head thrust forward, and the thorax considerably arched, while the back of the second segment of the abdomen bears a strong projection oddly resembling a Roman nose.

The butterflies of the genus include some of our showiest forms, the very queens of butterfly society, but they show a sadly depraved taste in their fondness for the ordure of animals fallen in the road. Their flight is lofty and sailing, and they are usually wary and easily alarmed. When resting in the sun, and especially when upon the leaves of trees, they often remain a long while with broadly expanded wings.

There is no American genus of butterflies whose habits in early life are more interesting. The eggs are laid upon the extreme tip of acuminate leaves, and the little caterpillar devours first that end of the leaf, sparing the midrib, to which it always retires after a meal. The favorite food-plants are the allied families Cupuliferæ, Betulaceæ, and Salicaceæ, and in the case of the present species Rosaceæ. The end of the rib is no sooner laid bare than it is coated and wound with silk, of the use of which these caterpillars are exceptionally free, and to this extremity are fixed bits of bitten leaf as small as grains of powder; at first there are but two or three fragments in line, but the number is afterwards increased, and being wound with silk they probably serve to stiffen the perch and prevent its curling as the rib dries. It is constantly strengthened by the addition of silk, the caterpillar adding threads and patching weak places as it passes back and forth to its feeding ground. When not feeding the caterpillar always occupies this perch, its head to one side; it assumes, in fact, a twisted position, holding on by its abdominal legs only, while the fore part of the body is bent down by the side of and somewhat under the perch. It has the curious habit of accumulating little scraps of leaf at the base and under side of the perch into an open packet of riffraff, and this is moved as the leaf is eaten, so as always to hang close to the cut edge of the leaf. This edge, in narrow leaves and at first in broader ones, is kept nearly square by eating first on one and then on the opposite side of the leaf. Occasionally a canal is eaten from the edge of the leaf, parallel to the eaten edge all the way to the midrib; as the bit of leaf left unsupported begins to droop, guys are spun from it to the solid leaf on the opposite side of the canal and to the midrib; it is then eaten away from the leaf, and the triangular bit remaining falls hanging by its threads and swings to the base of the perch, or is pulled there by attaching successively shorter threads. The packet is left behind and not increased after the second stage is passed, and now the caterpillar no longer frequents the perch, which has become too weak for its weight; hereafter it prefers twigs or the footstalk of leaves as a steadier ground.

But if the proper season has now arrived, it begins by this time to construct its winter quarters. In most cases the caterpillar finds that the bit of leaf on which it is resting will answer its purposes and is already of the proper shape and size, but not infrequently it attacks a new leaf, which it does by cutting channels down the lobes, very much as we should use a pair of scissors, to remove the superfluous portions, leaving finally a fiddle-shaped piece next the base. This is then smeared with silk on the upper surface, the opposite edges brought together overhead as nearly as possible, the interstices thoroughly covered with silk, and the resulting cylinder is found exactly to fit the caterpillar's body, now shrunken somewhat from its severe labors; the leaf stalk is attached very firmly to the stem by threads passing very many times entirely around it, and the hibernaculum is ready for occupancy.

The caterpillars thus hibernate when less than half grown, and the present species appears to be partly single, partly double brooded. The caterpillars probably begin to resume feeding as soon as the leaves of their food-plant begin to burst, and they thereafter quit their hibernaculum; but they feed slowly and do not change to chrysalis until June or July, the pupal state continuing ten or twelve days. The butterflies appear in the southernmost parts of New England from the 5th to the 10th of June, though only in limited numbers; in the latitude of Boston they seldom appear before the 18th or 20th, although single specimens have been seen by the 12th or 15th, and they do not become abundant before the close of the month. The butterflies continue to emerge from the chrysalis until nearly the middle of July, and are still seen in early August. The eggs are laid in July, at least as early as the 10th, and some at least of the butterflies produced from them are on the wing long before the middle of August, seldom appearing about Boston before the 20th, but in the Connecticut valley a week or more earlier, and flying through the month of September. Owing possibly to the attacks of parasites more efficaciously on this summer brood of caterpillars, but far more probably to the peculiarity of its history, as in allied forms, namely, that some of the August caterpillars grow to maturity the same year, while others grow more slowly and hibernate when half grown (the spring brood of butterflies being thus made up from both broods of the previous year's caterpillars), this second brood is considerably less abundant than the first and does not last so long, specimens of the earlier generation being seen even after the appearance of the second brood; while all of the latter have disappeared early in October. These last lay their eggs at the very end of August and in September, and the caterpillars hibernate after the first or second moult.

In the south, there are probably two broods previous to the late summer brood, the first appearing before the middle of April and lasting until the appearance of the second brood, which seems to be more abundant than the first; it appears early in June, and continues to emerge from the chrysalis until nearly the last of July and to fly through August.

The butterfly is addicted to roads, especially to such as are partially shaded, to forest paths, and warm sandy places bordering on woods. More even than the other species of the genus, it is extraordinarily attracted by dung of all sorts, the juices of which would seem to afford a strange satisfaction to so magnificent a butterfly.

East of and including the Mississippi valley this butterfly occurs from the Gulf to about the forty-third degree of latitude. In New England it is tolerably abundant in the southern portion, but has only been taken in a few instances north of Massachusetts, and then not far to the north. In

Canada it has only been recorded from Essex County, in Ontario.

But along its northern limits, which are nearly the same as the southern limits of the next species, and nowhere else, there occurs a form intermediate between the two, about which there has been some controversy, but which is probably a hybrid between them. Hybrids among butterflies are not common, and this, if it be a true case, is one which occurs more frequently and regularly than is otherwise known in this country; some of the other cases are between species of the same genus.

BASILARCHIA ARTHEMIS — THE BANDED PURPLE

THE second species of Basilarchia, to which we now come, has ever been a special favorite of mine. I easily recall my excitement in student days at the first sight of it upon the wing in the "Hopper" of Greylock, among the Berkshire Hills, and how every visit to that delicious mountain valley during its season was made glad by a sight of this, my "first love;" a gladness often renewed in later visits to the glens in the White Mountains of New Hampshire. What, indeed, can be more entrancing than the sight of a bevy of these showy insects, with a broad white bow stretched across the rich purplish black of their wings (Plate III., Fig. 2), floating or fluttering with easy abandon about a damp spot in the wooded road from which they have been disturbed by a passer-by? It is only or principally in mountain valleys that we may find them in the southern part of their range, which, except along mountain chains, hardly extends beyond the northernmost tier of States bordering the Dominion of Canada, from the Atlantic to the Great Plains. It ranges far north in Canada beyond the settled districts, though it has not been reported from any part of Labrador.

In New England it has not been taken south of Massachusetts except in single examples, and but rarely in that State. It is, however, not uncommon in the Berkshire Hills and in the hilly region just east of the Connecticut River, and once in a while appears in some numbers about Boston. In the White Mountain region, and in northern New England generally, it is exceedingly abundant, far more so than the other species of this genus in their most favorable localities. Indeed the matrons of farmhouses in the Peabody valley complain of their entering the kitchens in such numbers as to be a veritable nuisance, one of them relating how she had taken more than fifty on the inside of her windows in a single morning. It is one of the delights of camp life in that region to meet this butterfly.

To describe in general terms the early stages of this insect or its habits at that time would be but to repeat what has just been said regarding its next neighbor. Its preferential food-plant is the black birch, and the eggs are laid almost exclusively upon horizontally extended branches of small plants, not more than two or three feet high, skirting roadsides; they are laid singly upon the upper surface of the finely tapering leaves, and so close to the tip that the egg is just about as wide as the leaf at that point.

The hibernacula of the caterpillar are in all respects similar to those made by its allies. It begins to make them in the White Mountains by the middle of August, while the days are still hot, and a caterpillar is sometimes as many as ten days in making one quite to its liking. Into the little cylinder it now crawls headforemost, its tubercular hinder end visible and forming a sort of living door to its abode; here it remains the winter through, and as it has lived up to this time on the same low plant on which it was born, it is buried in snow the greater and colder part of the winter. This I found by examining thousands of trees by the roadsides in the White Mountain valleys very early in the spring, when search for the hibernacula was easiest,[1] and I found that fully nine out of ten were within from two to three feet from the ground, well below the average depth of the snow in that region. With the first starting of the leaves into new life the caterpillar backs out of its retreat and begins to feed upon the tender green; but either it first changes its skin, or it returns to the perch of its dried-up and inedible hibernaculum leaf after its probably scanty meals, for these will nearly always be found, soon after the caterpillar has finally quit them, to have upon the apical flap the cast-off pellicle of the caterpillar.

It is not a little remarkable that there is a Notodontian (moth) caterpillar found in some numbers on the black birch in the White Mountains, which eats the leaf in precisely the same way as this insect does, and simulates its habits, even to taking its siesta on the denuded midrib of the apex of the leaf; but it makes no hibernaculum and no such pad of riffraff next the ragged part of the leaf as Basilarchia does. A similar relation has been noticed in Europe between the caterpillars of *Najas populi* (closely allied to Basilarchia) and *Notodonta ziczac*, which feed in a similar way on Populus.

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[1] Not so easy as it would be if the hibernaculum had not a most remarkable resemblance to the bursting buds and curving terminal shoots of the birch at this season, a resemblance both in color and in form.

The hibernating caterpillar awakes, as we have said, with the dawn of spring, in the White Mountains in the latter half of May. It feeds for a few weeks, the chrysalis hangs for from nine to twelve or fourteen days, and then the butterflies appear on the wing. In the White Mountains the first brood of butterflies usually appears from the 16th to the 20th of June, and becomes abundant in four or five days; sometimes its appearance is considerably delayed, and the numbers increase by the advent of fresh specimens for about three weeks; the latest emergence of which I have exact date is July 18. By the middle of July the numbers perceptibly diminish, but it remains on the wing until early in August, and a few dilapidated specimens, mostly males, may be found even to the middle of that month, possibly a few days later. After the first days of July, however, almost no perfect specimens can be found, for the wings of fresh specimens become torn and ragged in a very few days, although their colors may be undimmed.

How early preparations are made for another brood my own observations do not show, but I am inclined to believe that the butterfly begins to lay eggs in the early part, or at least by the middle, of July, and that eggs are laid until the end of the month, very rarely in August, perhaps never after its first week. The eggs hatch in about a week, and the caterpillar may therefore be found in its first stage between mid-July and mid-August. As the caterpillars are at first slow feeders and slow growers, those which are latest may sometimes be cut off by early and severe frosts; others, and probably the mass of them, reach their second or third stage before the approach of winter; in the White Mountains they begin to make their hibernacula by the middle of August, and can rarely if ever be found feeding, except for such preparation, after the 25th of that month. Others, again, the earliest out of egg, may in a favorable season, and in considerable numbers, reach their third stage in midsummer, and so pass on to chrysalis and to a second or supplementary brood of butterflies, which makes its appearance late in August, probably never before the 20th, and becomes fairly abundant by the 1st of September. This is in no way so numerous as the first brood, and disappears by the middle of September. On account of its late appearance it is probable that the greater part, possibly all, of the caterpillars from this brood of butterflies — if indeed they lay eggs at all — perish before they are old enough to construct hibernacula.

These late August butterflies, which have only been observed in certain years, should be looked upon rather as an attempt toward a second brood than a regularly recurring event.

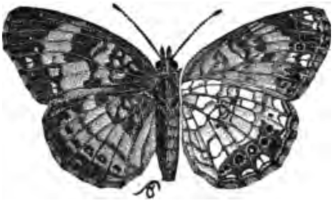
This is a very active butterfly and has a rather short and rapid flight. When they alight on trees they keep in motion over the leaves, walking about, spreading and folding their wings. Although they sometimes mount to the tops of trees, they usually fly only two or three feet above the ground along the road, sailing on broad wings rather than flying, or if not sailing, moving slowly with a rapid but very short flutter. They are very social in their nature, and may always be found in companies on the moist ground about the water troughs placed by the roadside in the hilly country, and they start almost from beneath one's feet in the gloomiest part of the damp forest road, where, if one but wait patiently, the startled beauties will reassemble, and the choicest may be selected for capture at will. When thus alighted near together, they are nearly always still very active, changing their position so constantly and crowding so against one another that their wings are soon abraded. A perfect specimen three days out of chrysalis is a rarity.

CHARIDRYAS NYCTEIS — THE SILVER CRESCENT

THIS butterfly has a close general resemblance to the Pearl Crescent, which we have already discussed. It is a little larger, expanding about an inch and three quarters; the markings of the upper surface are rather heavier, and beneath, the spots and dashes of the hind wings are more frequently inclined to silvery; moreover, the dots of the submarginal row, the repetition of those found on the upper surface, are delicately ocellated.

It is widely spread over our northern States, as well as in Canada. To the north it has been found on the Saguenay, at Quebec, Montreal, Sudbury, Ontario, and on the north shore of Lake Superior. It extends southward along the Atlantic coast to Virginia and North Carolina; otherwise east of the Mississippi it has not been recorded further south than the Ohio River. It is far more abundant on the western prairies than in the Atlantic States, and westward it extends from the North Saskatchewan to Nebraska, Kansas, Colorado, New Mexico, Arizona, and northern Texas. In New England it is very rare, and occurs almost exclusively on elevated ground, but it has been taken in every State except perhaps Vermont and Rhode Island. It is generally found in damp shady spots, in ravines, or by quick-flowing streams.

The eggs are broad at the base, and have their sides ribbed above, with sixteen or seventeen low vertical ribs, pitted in the middle, smooth below, and pale green, and are laid on the under surface of a leaf of the food-plant in clusters of from a few up to a hundred, side by side, in regular rows. The caterpillars are cylindrical, furnished with a dorsal row, and on each side four lateral rows of thorny tubercular spines, of which one row on either side lies below the spiracles; the head is shining black and the body velvety black above, with a dull orange stigmatal band, the spines black. They feed upon various composite plants, particularly on sunflower and Actinomeris. When young they are gregarious, as caterpillars from eggs laid in batches always are, at least at first, and feed only on the parenchyma of the leaf, leaving the transparent membrane, and, when alarmed by any sudden movement of the plant, let go their hold, coil their bodies, and drop to the ground; whence, if not again disturbed, they soon seek the plant again. At a later stage they consume the whole surface of the leaf, which becomes very foul from the excrementitious matter mixing with the juices of the



leaf; but the caterpillars "emerge from the mire as clean as a mole from under the ground." When they wish to moult, they spin a slight web on a leaf for a secure foothold, but they at no time construct one for concealment or protection like some of their allies. They hibernate in this stage.

We have already given a number of instances in which the winter is passed by a butterfly in the larval state. Certainly a quarter, not unlikely one half, of the butterflies of our northern States survive the winter as caterpillars; and in the larger part of these the very existence of the species depends upon their power of survival in this condition. Most of them pass the winter, like the present species, partly grown; some, as the species of Thanaos, fully grown, partaking of no further nourishment when the winter is passed, but changing to chrysalis almost or actually before their food-plant puts forth its leaves in the spring. Others still, and among them most Satyrids and Fritillaries, winter as young caterpillars just hatched from the egg, generally before they have touched a morsel of vegetable food, though their natural food-plant, upon which they were born, still offers sufficiently tender leaves. Of the species represented in this last category, some are not wholly dependent upon the survival of these delicate creatures, but accompanying them are half-grown caterpillars of a previous brood.

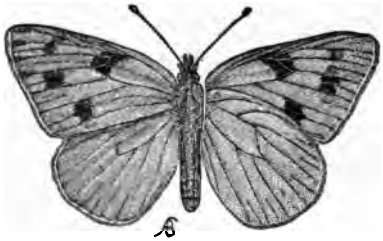
The most surprising fact we find here is the hibernation of young caterpillars just born. As they eat nothing, one would think they might at least have had the protection of the eggshell and wintered within the same; but, in the cases in point, the eggs are naturally laid upon the leaves of plants which die down in the winter; nevertheless, it has been thought probable that they may sometimes so remain and not emerge until the spring. I suspect also that the caterpillars are fully formed in the case of those Hairstreaks and Coppers which hibernate in the egg state; for with some of these the eggs are laid in midsummer and do not hatch till early spring.

Hibernation at this tender age is all the more surprising from the fact, known only too well to every one who has attempted to raise butterflies from the egg, that the greatest mortality exists among caterpillars in the first stage of existence, whether from natural causes or from the attacks of enemies, and also because in no case do those apparently helpless little creatures, generally but two or three millimetres long, construct any sort of a nest or retreat for their common or their individual protection. They merely seek hiding-places in curled leaves, in the ground, in crevices of bark and similar spots, where they are certainly not out of the way of mites and ants. Neither have they any defensive appendages which are not shared with other juvenile caterpillars which do not hibernate. Yet there is no evidence from any poverty of butterflies in these groups that they do not retain as good a hold upon the fauna as those species which do not pass what would seem to be so perilous a winter.

With few exceptions, of which the Silver Crescent is one, all other hibernating caterpillars pass the winter in some sort of a nest; most of them, separately or collectively, in one which has already given them protection during their partially completed larval life, but generally specially strengthened or enlarged for the purpose, and almost always with all approaches closely sealed. The species of Basilarchia are the only ones among New England butterflies which construct nests for the single purpose of wintering in them, and which they use at no other time; here each individual makes for itself its separate nest. Euphydryas, however, alters and strengthens its social nest for the winter to such an extent that its appearance then is quite different; and in the centre, as the nest contracts with the withering of the leaves, the caterpillars are crowded together into an almost solid mass. The other larger caterpillars, which make no nest, probably seek merely some cranny upon or near the ground wherein to lie concealed during the winter. There is then no little variety among our native butterflies even in such an apparently simple matter as the hibernation of the caterpillar.

But to return to our Silver Crescent. On emerging from its hiding-place in the spring, the caterpillar, which then feeds singly, grows slowly until June, when it turns to chrysalis. The chrysalis is pale yellow-brown, marked with blackish streaks, is not very angular, and has on the abdomen several rows of small conical tubercles. In about ten or fifteen days thereafter the butterfly appears. The earliest males are seen about the middle of June, but do not become common until the females emerge, generally early in July; the latter are not common until the middle of the month, when, or a little later, they begin to predominate, and the males to be worn and dull; the females continue at least throughout July. The eggs must be laid at once, and hatch in from nine to fourteen days. The caterpillars moult two or three times before hibernating, the earliest ones becoming dormant by the middle of July, while others are delayed until the end of August. All this refers to the north, where the insect is single-brooded.

Further south, the history is a much more complicated one; in the latitude of West Virginia and Missouri it is probable that the insect is partially single and partially double-brooded. This curious condition is brought about by the fact that a portion of the caterpillars born from the first brood of butterflies pass through their stages in an ordinary manner and produce in time a second brood the same season; while another portion, lagging at first behind their brethren, often from the same batch of eggs, finally pass, at the hibernating age, into a state of lethargy while it is still midsummer, or even by the end of June. They even assume at this early period the livery they wear through the winter, which is of a russet color, and not black as in their brethren of the same age who are not laggards. Of the earliest hatched caterpillars of the season, about one third become dormant at the hibernating age; while later on, with those of the first brood which hatch in midsummer, two thirds become dormant at the same age, while the others complete their transformations the same year.



PONTIA PROTODICE — THE CHECKERED WHITE

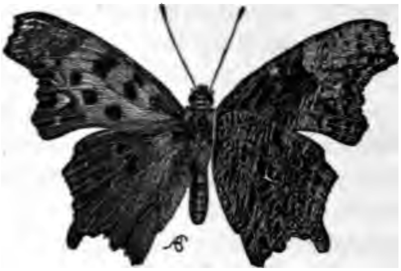
BUTTERFLIES with a pure white ground-color have a peculiar attraction, perhaps in part because this color is so unusual in butterflies and in such contrast to the green background of the warm season. We have in the north but very few of them, and they are all closely related. Of these the Checkered White is the largest and the most heavily marked with black, the spots being also more frequently of a squarish shape. It is widely distributed in North America, especially in the interior portions. The Mississippi valley seems to be its metropolis, but it occurs from ocean to ocean. On the Pacific coast it is recorded from British Columbia to central California, and on the Atlantic from New York and Connecticut to northern Florida. It has been found everywhere below timber in Colorado and Utah, and in the southwest it has been brought from Arizona, central and southern Texas, northern Mexico, and even the highlands of Guatemala. It is common all along the Gulf coast, but is reported as rare in Florida and Georgia, and does not appear to extend any considerable distance down the peninsula of Florida. In the northwest it has been found as far as Belly River, a tributary of the Saskatchewan, and has been taken in Dakota and Minnesota. It has even been reported from Hudson Bay, but perhaps by mistake for another species, since, though it is common in Wisconsin, Michigan, and Ohio, it has but rarely been taken in any abundance even in southern Ontario, and but a single capture is recorded from Montreal. Indeed, east of the Alleghanies it has seldom been seen in any great numbers, though it is occasionally common. Brockport, in western New York, and Newburgh, Staten Island, and Long Island, in the eastern part, are the only records from New York. In New England it is now and then seen, and is occasionally common in some of the warmer parts, mostly in Connecticut and nowhere else but in Massachusetts and Rhode Island, the only localities in the former being in the neighborhood of Boston and of Springfield.

The eggs are tall sugar-loaf shaped, marked vertically with about fourteen ribs, and of a pale color. The caterpillars are slender cylindrical worms with a yellow head, the body striped with golden yellow and dark greenish-purple and dotted with minute black warts, from each of which arises a short hair. They feed upon various cruciferous plants, but especially upon cabbage, of which they devour the outer leaves only, but may still be very destructive. The chrysalids are light bluish-gray dotted with black and with a few yellowish stripes, end in front with a conical projection, and have compressed angular ridges on the middle of the back of the thorax and the sides of the front of the abdomen. The butterfly has a rapid flight, and is found about the low weeds of pastures, waste lands, and prairies, but seeks the cultivated lands for egg-laying, and is fond of the flowers of buckwheat.

The butterfly is triple-brooded, each successive generation more abundant than the preceding, which is the normal condition of things where there is no complex history. The first brood, indeed, is rarely noticed, as it appears very early in the spring and is scant in numbers; it differs slightly in the depth of the markings, so as to have been taken for a distinct species. The second brood appears late in June or early in July, and continues on the wing until the third brood makes its advent, the last of August; early in September this becomes abundant, and the butterflies continue to emerge from the chrysalis even into October, and fly, at least in the southern States, into November. The insect hibernates as a chrysalis, but the precise times of the appearance and duration of the early stages are little known, except that the eggs hatch in four days and the other stages are quickly passed.

The early spring generation was, as I have said, once taken to be a distinct species and given the name *vernalis.* Its relationship to the others has, however, been proved by breeding. But it is an interesting fact that the butterflies of this species which appear latest in the autumn when the nights become cool and from then until severe frosts, progressively approach the spring type; for the chrysalids from which the latter are born have passed the winter and also give out the butterfly when the nights are cool. In other dimorphic butterflies, the spring type is also occasionally seen in the autumn, but not so commonly as here.

It is a curious outcome of the introduction into this country of the European cabbage butterfly, *Pieris rapæ,* which has spread over the whole country as far as the Rocky Mountains from the Atlantic border, where it was brought by commerce, that it is beginning to oust the present species. In many places where the Checkered White was formerly extremely common it is now rare, and its place (economically speaking) taken by *Pieris rapæ.* It is a living visible instance of the perpetual struggle for existence among all classes of animals.



POLYGONIA PROGNE — THE GRAY COMMA

Among our angle-winged butterflies none are more attractive by their sprightliness, or more noticeable by the extreme irregularity of their wing-outline, than the Polygonias, which look as if some hungry enemy had begun to feed on them, or as if their wings had been sadly frayed in contest with a hurricane. They all have a silver C or L stamped, as it were, in the centre of the under side of their hind wings, and all winter as butterflies; one of them, the Violet-tip, we have already discussed on its first appearance in the spring. Now we come to another, as its fresh brood makes its appearance. It is the least brilliant of them all, and is called the Gray Comma from the nearly uniform dark ashen gray tint of the under surface, caused by the covering of a light brown ground with a web of slender wavy black threads having a general transverse direction. The Polygonias are distinguished from one another largely by the markings of the under surface, and this species is further characterized by having the silver spot in the centre of the hind wings in the form of a straight-sided L, instead of a curved C.

The range of this butterfly corresponds very closely with the upper half of that of the Violet-tip, but the limits are slightly removed to the northward. Although most properly considered a member of the Alleghanian fauna, it is not found in abundance toward the extreme southern limits of that district, while on the north it more frequently and considerably invades the region of the Canadian fauna. Its southernmost stations are apparently Maryland and West Virginia; in the north it occurs at Quebec, Montreal, Ottawa, Lake Superior, Belly River, and the lower Saskatchewan; in the west it has been taken in Wisconsin, Iowa, Nebraska, Wyoming, and Fort McLeod in Alberta; the last two are its westernmost known stations; in the east it has been found in Nova Scotia, on the lower St. Lawrence, and on Anticosti. In New England it is more generally distributed and universally common than any other species of the genus, but is somewhat more abundant in the southern than in the northern parts. In the White Mountains it is occasionally common, but is rarely seen above two thousand feet, above which it is replaced by the Green Comma; thus I found it only on the lower half of the wagon road from Fabyan's to the base of Mount Washington; it will probably be found to be relatively rare in the elevated regions of northern New Hampshire and Maine.

The eggs are pale green, barrel-shaped, but smaller above, and marked by ten thin vertical ribs; they are laid singly on the upper surfaces only of leaves, with little selection of the exact spot, excepting that they are frequently at the very edge; they hatch in four or five days.

The young caterpillar eats only the summit or at most the upper quarter of the egg in escaping from it, leaving the main walls untouched; its head is smooth at first and the body green with six longitudinal rows of long hairs, one to a segment in each row, arising from minute warts. When fully grown, the head is crowned by a pair of long, stout, bristly spines; while the body is yellowish-brown, uniformly variegated above with blackish olivaceous, and bears seven longitudinal rows of large warts, each surmounted by a long spine beset with whorls of delicate bristles.

It feeds upon currant, wild gooseberry, and probably any other grossulaceous plant, and also, more rarely upon elm; it occasionally does damage to cultivated fruits. It lives entirely exposed without making any form of nest (as other species of the genus sometimes do), relying for concealment only on its home on the under side of leaves. It has been suggested that from the resemblance of the caterpillar on well-shaded leaves to a yellow, partially dead leaf of gooseberry it may derive some protection. When feeding it eats the edges of the leaf in rather deep gashes, not avoiding the midrib, and, detaching its terminal legs from the leaf, curves the last two segments upward. So when at rest it has, at least in the later stages, a habit of holding these terminal segments aloft, while the anterior segments are arched and turned at a right angle to the rest of the body — certainly an odd attitude, which must have some special meaning, if we only knew it. It eats but sparingly and grows with corresponding slowness; it is ordinarily very quiet, and feigns death when disturbed, but at times its movements are very rapid and uneasy.

The chrysalis is very angular and tuberculated, with a pair of conical projections in front, and on the middle of the back of the thorax a very prominent, strongly compressed elevation shaped somewhat like a Roman nose. In color it is greatly variegated with buff, olive-green, brown, white, and salmon-red, and is altogether a striking object. It hangs in this state usually from ten to sixteen days.

This insect is double-brooded, and, as already noted, passes the winter in the perfect state. The butterfly is one of the first to feel the approach of spring, appearing on sunny days at the end or even by the middle of March. Toward the close of April and early in May it flies in considerable numbers, and continues on the wing until early in June, occasionally to the middle. The eggs are laid, apparently, about the middle of May, and the caterpillars transform to chrysalids from about the middle of June to the early part of July, at least in the vicinity of Boston. The earliest butterflies from these chrysalids — the first brood proper of the season — generally appear in the first days of July, sometimes as soon as June 24; they are, however, seldom abundant before the second week in July, and continue to be seen until about the 10th of August, or in northern New England later than this. The eggs of this brood of butterflies are laid in July, generally in the latter half, and in northern New England up to the middle of August, the caterpillars change to chrysalids from about the middle of August until early in September, and the butterflies again appear, generally about the 22d or 23d, sometimes as early as the 18th of August, become abundant by the 1st of September, and continue to emerge from the chrysalis until at least the 8th of September. They may be found in much greater abundance than the first brood all through September, but by the middle of October nearly all of them have sought their winter quarters beneath a tree limb or in some sheltered crevice.

This wary and agile butterfly is rather difficult to capture; it must be by stealth. It frequents lanes and openings through light woods, and even dusty highways; at the least alarm it darts into the thicket, returning soon, however, to reconnoitre and, if the enemy is still in view, settling only at a safe distance. It is often seen sipping the juices of drying or decaying fruit. It is in the habit, also, along woodland roads, of alighting on the ground to enjoy the hot sunshine; and if now startled it quickly snaps its spread wings into an erect position. This habit has its meaning, for when its wings are spread only the upper surface, with its bright fulvous and black contrasting colors, is seen, and it is then anywhere conspicuous; while when the wings are closed the under surface alone is brought to view, and this, with its neutral tints, is very inconspicuous, even when the creature is seated on a green leaf, since it harmonizes so well with the colors of the trunk or bough of the tree, or with the ground. It changes in this instant from a conspicuous object to one quite inconspicuous, just as in the well-known case of the Leaf-butterfly of the Indian tropics, which has but to close its brilliant wings to disappear from sight. To this ingrained habit these butterflies undoubtedly often owe their life, and it exemplifies one of the many ways in which we see the survival of the fittest or the most cunning.

SPEYERIA IDALIA — THE REGAL FRITILLARY

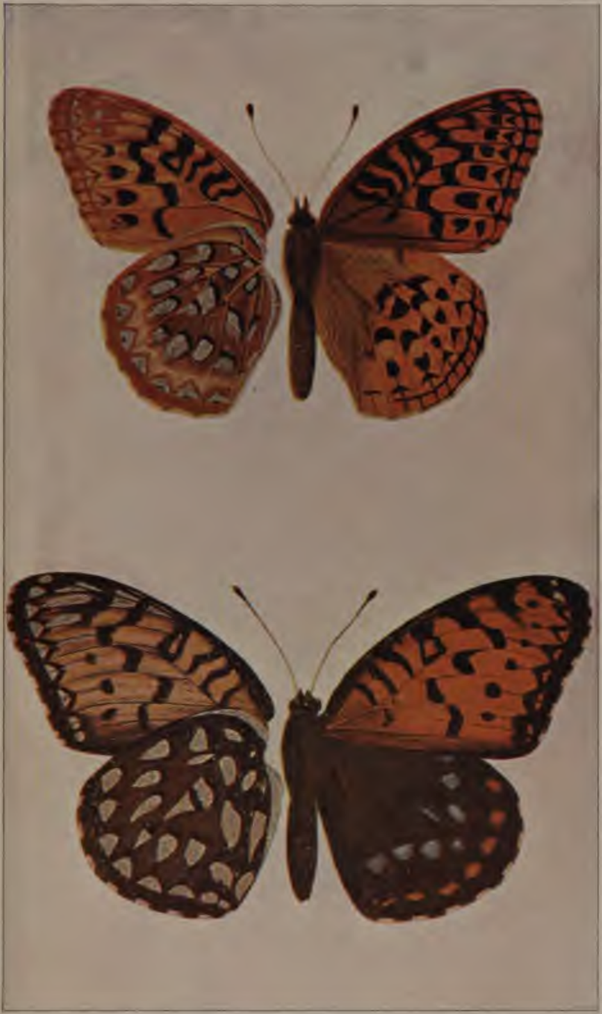
THIS is a superb butterfly, with its rich orange-red and blue-black coloring above, marked with black, orange, and white, and the large gleaming silvery spots of the under surface lying against a warm background. (Plate VII., Fig. 2.) The sexes differ in the color of the outer row of spots on the upper surface of the hind wings, these being orange in the male, whitish in the female. Very few of our butterflies can compare with this in rich coloring, and it is rare enough to make its capture noteworthy to the young entomologist.

Its distribution over the country seems to be somewhat irregular, though it is apparently confined to the Alleghanian fauna. It generally inhabits lowlands and seems to be much more abundant in the extreme eastern portion of its range than elsewhere, excepting on the western prairies. It occurs, however, as far south as the elevated parts of Georgia, for it was painted by Abbot nearly a century ago; but this is the only record of its occurrence on the Atlantic slope south of Pennsylvania. West of the Alleghanies it occurs in Ohio, but rarely, and in northern but not in southern Illinois; it is abundant in Wisconsin and

PLATE VII

1. Argynnis aphrodite

2. Speyeria idalia



has been taken in various parts of Iowa, Nebraska, and Kansas, as well as in Arkansas and Louisiana. It does not occur north of our border. In New England it is reported as abundant at several places in Connecticut, while in Massachusetts it has been found in restricted localities about Boston and at Leverett, Walpole, Montague, and Springfield; the only places where I have found it tolerably abundant are in Berkshire County, in the higher part of the State, and in the lowest on Cape Cod and Nantucket. In the latter island it occurs sparingly, except in a small district perhaps a half mile or mile square near the centre of the island, and mostly within an acre of ground. The most northerly stations from which it is recorded are in Maine west of the Kennebec River, New Hampshire only in the southern third, Williamstown, Mass., and Albany, N. Y.

It frequents open breezy meadows or pastures in close proximity to marshy lands or ponds. The place where I have found it most abundant is Nantucket, where it occurs sparingly near damp spots next the roadside, but most abundantly in the Middle Pasture, where in a half-acre patch of goldenrod, next the west end of Gibb's Pond, I have always found it in its season, and easier of capture than in the pasture lands adjoining. The place is entirely open. They appear fondest of alighting on the flowers of goldenrod and Vernonia, but are also partial, where these occur, to thistle and red clover. This butterfly has a bold and rather majestic flight, sailing frequently. It does not move with great rapidity even when frightened, nor is it often seen at any great height, generally flying about four feet from the ground. It is rather wary of approach, and will generally fly off in a somewhat labored fashion against the wind, but if pursued will in the most aggravating way keep just out of reach, or it may suddenly dart to one side, and then, expanding its wings to the full, be borne along hurriedly by the wind far to the rear of the pursuer. The flight of the female is much less vigorous and sustained than that of the male. The latter generally flies a little faster than one can walk hurriedly; the ample wings are flapped with great vigor, but do not seem adapted to swift flight. The male has a slight musky odor arising from scent scales or androconia lying along some of the branches of the vein behind the cell of the fore wings.

This butterfly is single-brooded, and appears on the wing with us occasionally as early as June 25, and then becomes tolerably common by the 1st of July, and abundant after the first week in that month; more commonly, however, its first appearance is delayed until the first week in July, and its subsequent abundance is correspondingly postponed. Males only can be found for the first ten to fifteen days, and the female is generally scarce before the latter part of July. Fresh specimens continue to emerge from the chrysalis until after the middle of August, so that some observers have thought them a second brood. The phenomenon is the same as we have seen in treating of the species of the allied genus Argynnis (p. 208), but there is as yet no proof of any interruption in the advent of fresh material in the southern part of the range of the present insect. The butterflies may be found on the wing until the end of the third week in September in the north, and probably later in the south. The eggs are not laid until long after the appearance of the earliest females, not indeed until August, commonly not until September, and I have had them laid as late as the middle of the month in Boston. The eggs hatch in from twenty-nine to thirty-three days, and the caterpillars go at once into winter quarters, the remainder of the history being carried out in the succeeding spring.

Females imprisoned by me in lace nets over growing violets, in the hope of securing eggs, lay indeed a few eggs on the violets, but these were as nothing to the hundreds they laid on the lace during a steamer voyage from Nantucket to Wood's Holl! These eggs were in all such cases laid erect upon the *outside* of the lace, the female thrusting the tip of its body through the mesh (double bobbinet), curving the tip around and depositing the egg on its base. The meshes were felt for as with a snout, and many would be tried and pierced before a satisfactory position seemed to be found. The action was repeatedly seen, and the net, sprinkled with eggs on the outside while the parents were within, had a very curious appearance.

This leads me to conclude that in nature the eggs are laid upon the under surface of the leaves by the parent seated on the upper surface. The eggs are short sugar-loaf in shape, with from sixteen to eighteen longitudinal ribs and pale green when first laid, afterward changing to purplish-fuscous.

The young caterpillar has a shining black head, and a dark olive luteous body adorned with numerous hairs nearly as long as the body is wide. When fully grown the head is red and black, and the body velvety black, banded and striped with ochrey yellow, and armed with bristly spines of a yellowish or silvery white color sometimes with orange bases. They have been raised on violets, but it is not improbable that their native food is some composite plant. The chrysalis is bulky, tuberculated, of a brown color tinged with pink, and marked with black in scattered small spots. It hangs for about seventeen days.

We have spoken of the difference between the sexes in this butterfly. Another large Fritillary, not treated of in this work (*Semnopsyche diana*), differs even more conspicuously in coloring and markings in the two sexes. It is found in the northern portion of our southern States, and the sexes differ to such a degree that they would never be taken at first sight for the same insect. It is, indeed, the most striking case of distinction between the sexes known among North American butterflies, and is the more interesting because the female, which is the aberrant form, so closely resembles another butterfly found in the same district, *Basilarchia astyanax*, that it may properly be regarded as a case of mimicry or protective resemblance. This is the stranger, because then some members of the genus Basilarchia mimic (see p. 105), while others are mimicked, and the mimicry in the latter case would seem to be a curiously second-hand affair.

ENODIA PORTLANDIA — THE PEARLY EYE

From one of the most brilliant and showy of our butterflies, we turn to one which, though dressed in Quaker drab, is scarcely less beautiful, with its happy blending of neutral tints. (Plate I., Fig. 3.) All the Satyrids, of which this is one, are of a modest and rather sombre coloring, which, however, is often enlivened, as here, by ocellated spots harmonizing admirably with the ground color. Of our species none show more chaste beauty than the one now before us, with its pearly gray tints and numerous large ocellate spots, encircled beneath by a lilac loop.

It is a widespread species, appertaining to the warmer parts of the United States east of the Great Plains, though occasionally taken far north. Its southern limit is the coast of the Gulf of Mexico, where it has been taken in Florida, Alabama, and Texas. Westward it extends to Arkansas, Missouri, Kansas, Nebraska, Iowa, and Wisconsin. Northward it has been reported in Manitoba, at the Lake of the Woods, Ontario, Montreal, Ottawa, and the Rouge District, Quebec, and even in Nova Scotia. Within the limits of New England it is very rare and apparently holds its own only at a few scattered localities. The best known locality is at Amherst Notch, and it has also been found on Mt. Tom and in different spots near Holyoke and Springfield, Mass. The only other recorded places of capture in New England are at Suncook and Jefferson, N. H., and Orono and Bangor, Me.

The eggs are nearly globular, smooth-shelled, and white, and hatch in from four to six days. The caterpillar feeds on grasses; when just from the egg it has a rounded head with slight conical elevations on the crown, and a slender body armed with several rows of long clubbed hairs. When mature the body is distinctly striped, with only a short pile, and the head is crowned by a pair of conical horns about as long as the breadth of the head, matching a longer pair extending backward from the last segment of the body, both pairs being tipped with red. The chrysalis is green, with few projections, and hangs by the tail. Its duration is from thirteen to sixteen days.

In the north the butterfly is single-brooded, and south as well as north appears to pass the winter as a partly grown caterpillar, moulting two or three times in the late summer, and twice more the succeeding spring. The butterflies appear in the north about the last of June, and fly throughout July and into August. The eggs seem to be laid only late in this period, and the caterpillars, surviving the winter, live for about ten months. In the south there are at least two broods, and there may be three, for the butterfly has been taken in West

Virginia as early as May 18, in Georgia April 25, and in Florida in the middle of February, and fresh examples may be found in West Virginia in June, July, and August, while eggs are laid as late as the end of August. May and August seem to be the culminating times of the southern broods, and the intermediate appearance of fresh individuals is probably due to their lingering in their early stages, as is not uncommon with the sluggish Satyrids, but the data from Florida would rather indicate three broods in the extreme south in February, May, and October.

The butterfly is a forest species, and has the habit of pitching on tree trunks, head downward, with closed wings. In the western prairie region it occurs only in the groves bordering streams, and in our eastern States is generally found in highways through woods, and especially in ravines or passes. It is a gamesome butterfly, and flies more strongly than most of our Satyrids, closing its wings back to back with something of a snap.

The English naturalist, Gosse, residing many years ago in Alabama, writes of it from there as follows: "A particular individual will frequent the foot of a particular tree for many successive days, contrary to the roaming habits of butterflies in general. Hence he will sally out on any other passing butterfly, either of his own or of another species; and, after performing sundry circumvolutions, retire to his chosen post of observation again. Occasionally I have seen another butterfly of the same species, after having had his amicable tussle, take likewise a stand on a neighboring spot; and after a few minutes' rest, both would simultaneously rush to the conflict, like knights at a tournament, and wheel and roll about in the air as before. Then each would return to his own place with the utmost precision, and presently renew the 'passage of arms' with the same result, for very many times in succession."

Another writer speaks of finding the butterfly common in a half-acre grove of open second growth of trees from fifteen to twenty feet high in northern Ohio. "When the sun shone clear it was usual to find a score or more of *portlandia* about one tree, sitting on the trunk, flying up and away a few feet, and returning to the same tree, apparently playing with each other. At the same time the great body of the butterflies seemed content with resting in the full sunlight on the tops of the leaves."

THECLA CALANUS—THE BANDED HAIRSTREAK

Sprightly little creatures are the Theclas, of which the present species is one of the commonest, and which is distinguished from its nearest fellows by the quadrate shape of the markings of the under side, which form a continuous band across the front wings. In its nearest allies these markings are either more or less circular, or the band formed by them is somewhat shifted in position as it crosses the wing. One will not fail to remark the elegance and precision of the delicate markings of these tiny butterflies, all of which have their most vivid and varied coloring centred about the base of the thread-like tail of the hind wings, and particularly on the under side. They are among the gems of the butterfly world.

The Banded Hairstreak (Plate II., Fig. 3) has a somewhat extensive distribution, at least in latitude, in the northeastern portion of the United States. Southward it occurs as far as Virginia, Georgia, and Alabama. Westward it reaches to Michigan, Wisconsin, and Iowa, and even to Nebraska, Kansas, Colorado, New Mexico, and northern Texas. There is some reason to believe that it is even found in California. Northward it has been taken at Montreal and Ottawa and in western Ontario. It seems to occur throughout most of New England, but has been taken in Maine only at Norway; in New Hampshire it has occurred at Walpole, Milford, and other points in the south; in Vermont at Bellows Falls; in Massachusetts at numerous places all over the State; in Rhode Island at Providence; and in Connecticut at Plantsville and New Britain.

The eggs are pale green, turban-shaped, and studded with numerous minute knobs; they are laid on twigs of the food-plant. The caterpillars are slug-shaped, and vary greatly in markings from a nearly immaculate grass-green to an impure tint marked with a broad and greatly interrupted dorsal stripe. The chrysalis is compact and rounded, of a brown color, dotted with darker spots.

The food-plants of the caterpillar are oaks, hickory, and butternut, and perhaps thorn; the caterpillar devours the leaves by eating holes through them; it is rather slow in its movements, and in captivity, if not supplied with food sufficiently fresh for its taste, is apt to turn cannibal, and devour its younger and weaker brethren.

The butterfly makes its first appearance in the north toward the end of June, and continues to emerge from the chrysalis until after the first week in July, and the females probably throughout July. It is much more abundant during July than subsequently, but occurs also during the whole of August, and has even been taken the first week in September, but whether taken in June or September, all belong to one brood, which is a long time for a midsummer butterfly to be on the wing. Eggs are laid all through July and early in August, if not later, and perhaps sometimes remain unhatched throughout the winter. At other times they hatch in a few days; but it is tolerably certain that when they hatch, the caterpillars hibernate without eating, as there is no indication that there is a second brood even in the south. Eggs I have had early in August did not hatch, and caterpillars found in the spring, after the revival of vegetation, are but partly grown, whether found in the northern or the southern States. It is usually not until toward the last of June in the north, sometimes not until July, that the caterpillars are full grown, and after passing from fourteen to twenty days in the chrysalis emerge as butterflies. In the south, the butterflies emerge late in April, after twelve days in chrysalis.

I have always found the butterflies about shrubbery, generally away from cultivation, and in the vicinity of small or scrub oaks. In the west they are reported as taken at the bottom of ravines in low thick growth of timber, and on flowers of Symphoricarpus growing in hollows on the prairies, which are moist in spring. Their flight is short, rapid, vigorous, and quixotic. When at rest on leaves of trees in the sun, they have a habit very common among the Gossamer-winged butterflies of rubbing their hind wings upon each other, alternately up and down.

Like other species of the genus, the male has a small discolored patch on the upper surface of the middle of the fore wings, containing the scales peculiar to this sex. It is an easy mark to distinguish the male from the female.

ARGYNNIS APHRODITE—THE SILVER-SPOT FRITILLARY

WE have already discussed two of our three eastern species of Argynnis; in most districts the present species (Plate VII., Fig. 1) is on the whole the commonest of the three, and differs from the others in the narrowness of the buff belt between the two outer series of silvery spots on the under side of the hind wings. In size it is intermediate between the others.

In eastern America the range of this butterfly is much the same as that of *Argynnis cybele;* but whereas *cybele* prevails in the south and is scarce in the north, *aphrodite* is rare in the south, that is, in the southern quarter of the Alleghanian fauna, and abounds in the north, not infrequently encroaching upon the Canadian fauna. As an instance of the relations of the two, it is said that *cybele* is but little more abundant than *aphrodite* in the vicinity of Newburgh, N. Y., while in the Catskills the latter abounds and *cybele* is rare. The most southern districts from which the present species is recorded are high lands in West Virginia, North Carolina, and Tennessee. Eastward it is common as far as Nova Scotia: and to the west it occurs in Ohio, southern Michigan, Illinois, Wisconsin, Iowa, Kansas, and Nebraska. To the north it has been found as far as Hudson Bay, Lake of the Woods, Lake Superior, and at various points on the lower St. Lawrence. In New England it is one of our commonest butterflies, and seems to be very generally distributed, but it is wholly absent from the heart of the White Mountains.

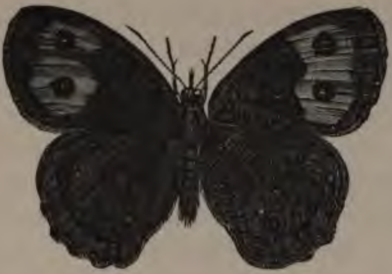
The butterflies are excessively fond of flowers, and when feeding are so engrossed therewith that they can be taken readily with the fingers. In July the sterile hillsides of New England, overgrown with thistles, seem fairly alive with them. They frequent also low meadows, and usually fly near the ground. The males have no perceptible odor. The eggs are short sugar-loaf shaped, no higher than the basal breadth, ornamented with from sixteen to nineteen rather prominent vertical ribs connected by distinct cross-lines, and are honey-yellow. The young caterpillar just from the egg has a blackish head and greenish body, covered by ten rows of long, clubbed, delicately spiculiferous hairs seated on tubercles. The full-grown caterpillar has a blackish-brown body, with a velvety black spot at the base of each spine, and is profusely armed with long tapering spines arranged in six longitudinal rows, and beset with numerous spreading bristles. The caterpillars, on hatching, devour their eggshells, and then move actively about as if quite equal to finding suitable winter quarters, utterly declining further food, even though placed on a growing violet, for they hibernate at this stage.

In the spring they feed nightly on all kinds of wild violet, and during the day lie concealed on the ground beneath chips and stones; but their growth is slow, and they are active only on sunny days, neither feeding nor moving in cold or cloudy weather. After remaining motionless for hours, they will suddenly arouse and start off in extreme haste, running all about any inclosure in which they may be kept, and, on finally reaching leaves, will feed ravenously and then return to their resting-place; not infrequently they extend themselves on stones or the damp earth as if for coolness. They pass from an extreme of haste to a nearly complete lethargy. In the only instance known where one was carried through all its stages in confinement, the caterpillar, when about to pupate, made for itself a tent of the leaves of the plant, on which it was kept, by weaving them loosely together, so low down that when in suspension it would nearly touch the ground. The chrysalis is chestnut-brown, irrorate with black, somewhat angulate, with only moderate prominences. It hangs for from seventeen to twenty days.

The history of this butterfly is in general similar to that of *Argynnis cybele*, since it is single-brooded and hibernates as a caterpillar just from the egg. In any given locality, however, where it is found in company with the other species of the genus, it is the last to appear. The butterflies make their advent about the first of July, though single specimens are sometimes taken in the latter part of

June. They are seldom abundant before the end of the first week of July, and continue plentiful, their numbers replenished by fresh specimens until the middle of the latter half of August, after which they fly in constantly diminishing numbers until the middle or latter part of September, when they finally vanish. The eggs are not laid until the middle and latter part of August and in September, and hatch in from two to three weeks.

The whole history of this insect, and especially the curious fact that the eggs are never laid before the middle of August, although the butterflies have been flying for six weeks or more, looks like a determination on the part of Argynnis — for it is a common feature in all our eastern species at least — that it will not be beguiled into trying to raise two broods a year, though time for this would seem to be sufficient. As butterflies of both sexes continue to emerge from the chrysalis at least to the time of egg-laying, it is natural to ask whether the eggs are laid by the old or by the fresh females, or by both. This we do not know; but since the whole race starts alike in the spring, and it is not known that there is any noticeable variation in the duration of the chrysalis stage, it is plain that there must be an unusual degree of variation in the duration of the life of the caterpillar, and that their lethargic tendencies are often given full swing in midsummer. Caterpillars which start alike in spring, and after spring opens vary in the length of their life from six to fifteen weeks, must depend for such a difference on periods of lethargy for some not shared by others; and if it is only the late-born butterflies that lay eggs, the only hope of progeny is in those butterflies whose caterpillars have been most lethargic. There is here much to learn, and we need to know much more about the details of the actual life of the Argynnis butterflies before we can comprehend the meaning of such facts as are known.



CERCYONIS ALOPE — THE BLUE-EYED GRAYLING

THIS butterfly has ample rounded wings, of a rich dark brown above, having as special markings on the fore wings a pair of dark ocellated spots inclosed in a broad yellowish band; beneath, the wings are irrorate with short, dark transverse threads on a lighter brown base, and the markings of the upper surface are repeated.

It is a characteristic butterfly of the eastern United States, where it is found about as far north as the latitude of the middle of New England, and as far south as about the middle of the States bordering on the Gulf of Mexico; westward it extends to northern Texas, Missouri, Kansas, and Iowa. It is found in Wisconsin, in the southern half of Michigan, the lower parts of Ontario, and throughout most of New York. Specimens are occasionally taken further north. In New England it is tolerably abundant, sometimes very common in the southern half, occurring throughout Massachusetts and the States south of it, and in the southern extremities of the States to the north. The most northern localities known to me are Portland and Norway, Me., Thornton and Shelburne, N. H., and Sudbury and Stowe, Vt. It has also been taken in New Brunswick and even in Nova Scotia.

The butterfly occurs in open woods and orchards as well as along roadsides and stone walls, especially such as are overgrown with brambles or skirted by shrubbery; it may also be seen flying in grassy meadows. It has a stronger flight than most of our Satyrids, occasionally a prolonged and rapid one; but it may usually be seen tossing itself lazily in and out among the shrubbery at the edge of a wood, or by the bushes beside unfrequented roads. Gosse describes it as wary in Alabama and flying swiftly, chiefly affecting lanes in the forests, but occasionally coming into the gardens in the early morning. On the prairies of the west it is said to frequent the flowers of Coreopsis, and may be found in great numbers in the east on the flowers of hardhack, which bloom in old fields in July. When found in considerable numbers it sometimes develops a certain amount of playfulness in contact with its mates. Thus one writer speaks of a group, some thirty in number, as showing a strong manifestation of fun and frolic: "Such wild gambols on the wing I never saw, often in one compact cluster, wings and legs and antennæ in a confused jumble, then off in pairs, then in two crowds, with all the marks of 'mirth and jocund din.' Such scenes certainly appear like an intelligent appreciation of fun, as they clearly have no reference to any necessary functions of body, and seem intended only for gratification."

At night the butterfly rests upon the branches of low trees or shrubs, probably hanging from the under surface of the twigs. At least this is the conclusion reached by my experience in driving over the Nantucket moors one August day. The wagon track along the broad main road is here lined for a part of the way with a row of low pine-trees, with an occasional scrub oak; the wind was blowing across the road; it was about six o'clock in the morning, and not a butterfly was naturally astir, but, as we rumbled along the road, hundreds of this butterfly were swept across our track by the wind, forming, indeed, a continuous stream as long as the fringe of trees continued. As close an examination as could be given without stopping (I was bound for the steamer) showed that they all came from the pine-trees; that they rose just as our horse's head was directly opposite them, and, wafted by the wind across our track, sank drowsily to the ground the other side. The trees were from eight to ten feet high, and about twenty feet distant from the track we took, and no butterflies were seen to leave the trees at any much higher or lower level than five feet, nor any from the ground. They were doubtless started from sleep by the tremor of the ground.

The eggs are short, barrel-shaped, but tumid with about twenty-five vertical ribs, and honey-yellow when laid, afterwards turning pinkish. The caterpillars just from the egg are stout, with a brown head and pale brown body; the latter is furnished with a half dozen rows of little warts bearing long bent and compressed appendages, those of the front of the body directed forward, and those of the hinder part backward, giving them a very strange appearance. The full-grown caterpillars, on the other hand, are slender, with a grass-green head and body, the latter merely pubescent and delicately striped, with lighter and darker green. The food-plant is grass. The chrysalis hangs by the tail, is well rounded, has an alar ridge, angulate prominences in front, and a rapidly tapering, pointed, smooth abdomen; it is grass-green, the prominences pale-straw color.

In the southern parts of New England, the butterfly makes its appearance early in July. Dr. Harris records it in his manuscript as once taken July 1, and I once thought I saw this species at Granby, Mass., on the same day of the month; but it is very seldom seen before the 5th, and in the vicinity of Boston, the 10th or 12th; a few days later, sometimes not until the 17th or 20th, it appears in the more elevated parts of Massachusetts and in southern New Hampshire. It continues to emerge from the chrysalis throughout the whole of July, and remains abundant throughout most or all of August, and may be taken until the middle of September. The females appear less than a week after the advent of the males, but do not begin to lay eggs until toward the middle of August, a long time after their first appearance, and continue depositing until far into September. The earliest that I have myself secured were obtained by a friend at Springfield, Mass., between the 22d and the 27th; others were secured near Boston and at York, Me., on the 29th; still later ones were sent me from Milford, N. H., on September 6, and I have obtained them at Nantucket as late as September 10. Eggs have been secured by others, however, between August 10 and 18 at Martha's Vineyard, and at Stowe, Vt.

There is then but a single brood each year; that this holds good for the south as well as the north is probable, for specimens of the butterfly sent me from Texas were all collected in September, and, according to the collector, the females did not begin to lay their eggs until early in October, or at a period correspondingly near the colder season. Yet there may easily be some error in this, for they have been bred from the chrysalis in West Virginia as early as June 9. In escaping from the egg, the caterpillar bites around the uppermost part of the sides of the shell, throwing off the summit as a sort of lid, and generally leaving it attached to the shell by a slender hinge; the egg is then left intact. The eggs hatch in from twenty to twenty-seven days, usually from twenty-three to twenty-five, an exceptionally long time, though it may be reduced in the south to a fortnight; the caterpillars, therefore, do not appear in the northern States until September, or the very end of August, too close upon the winter season to enable them to attain any considerable growth in the autumn; and indeed, like most of our Satyrids, they hibernate without eating a morsel of vegetable food. It seems hardly probable that some of the eggs remain unhatched until the spring, since out of a large number observed, even the latest laid gave birth to caterpillars the same season, unless, from being unimpregnated, they shriveled up. Still their condition would seem to be very similar if they remained in the egg ready to eat their way out. They are slow eaters in the spring, being exceedingly lethargic in action, and even when full grown moving with excessive slowness, by almost imperceptible, nervous, forward twitches; they usually do not change to chrysalis before July, and after spending about a fortnight in that state appear again as butterflies.

CERCYONIS NEPHELE — THE DULL-EYED GRAYLING

THIS butterfly differs from the preceding mainly in that the large ocellate spots of the fore wing are inclosed in a very indistinct common pale band, or in none at all. It has sometimes been regarded as a dimorphic form or geographical race of the preceding species, and intermediate forms between the two are not uncommon. We shall speak of this point later on. In general it is easily separable.

Its distribution is much broader longitudinally and narrower latitudinally than that of *C. alope*. It is a more northern form, but the districts occupied by the two overlap at their common margins. It extends westward certainly as far as the foothills of the Rocky Mountains, where it has been taken north of our boundary, and in our own territory in the Judith and Big Horn Mountains, in Colorado and New Mexico. It is most abundant on the western prairies of Iowa, Wisconsin, and northern Illinois, and is found also in Kansas, Nebraska, Michigan, and eastward, north of about 42° of north latitude. It is reported as rare at London, but common at St. Catharines, Ontario; it occurs in northern Ohio; in New York, it has been taken in Albany and Schoharie counties, and at Nichols in Tioga County, and is common in the Catskills. Its northern limits are wholly unknown, reaching, perhaps, beyond the spread of settlements; its northernmost known occurrence is in the Athabasca region. It has not been reported from the lower St. Lawrence, but it is taken at Ottawa and Quebec, and is abundant in Nova Scotia. It is found over the whole northern half of New England in great abundance. The only locality where I have met with it in Massachusetts is in the Berkshire Hills, but it undoubtedly approaches closely to the northern limits of the State, and is found throughout Maine.

In its earlier stages it does not differ appreciably from the preceding species. The butterfly is found in open woods, and frequents the thistle in pasture ground near the edge of woods. In northern New England it usually makes its appearance a little before the middle of July. One observer at Hallowell, Me., says it appeared there in three successive years on July 12. It has, however, been taken at Ottawa, Canada, as early as June 28. In the west also it is earlier than in New England; but in the deeper valleys of the White Mountains it sometimes fails to make its appearance until nearly a month later. It does not continue on the wing quite so long as *C. alope*, at least in New England, but generally disappears in August. It is single-brooded. The butterfly has been taken pairing with *C. alope*. The eggs are laid on grass in the latter part of August, females under confinement often dropping them loosely on the ground. The eggs hatch in a month's time and the caterpillars go at once into hibernation. After hibernation, the color of the caterpillars at every stage is that of the grass on which they are feeding or very nearly so, and the caterpillars, although exceedingly slow in their motions, fall from the stem at the least alarm, so that they are protected against their enemies both by their coloring and their habits.

I have referred above to the doubt as to whether this species is distinct from the preceding, or whether they are but two forms of one. The latter has been claimed from the results of breeding, by which it has been shown that in the belt common to the two forms *alope* has produced intergrades between the two, and *nephele* both intergrades and *alope*. This would be conclusive if the complete parentage in each case were known; but as only the mother was known in any case, another explanation is not only possible, but in view of all the facts probable. The intergrades found throughout the belt forming the northern boundary of the typical *alope*, and the southern boundary of the typical *nephele*, seem to be far more easily explainable on the hypothesis of hybridism (and I have said that they have been found paired), since they occur only where such a phenomenon is possible and wherever it is possible. That the two species are certainly distinct I would by no means maintain; only that in view of the facts of distribution, it seems more probable that they should be looked upon as having reached in their development the stage of specific distinction, while they are readily fertile together and produce intergrades where they meet on common ground. It is a difficult question to settle, but the progress of experiment and research will doubtless some day determine the matter.

FENISECA TARQUINIUS — THE WANDERER

In the markings of its upper surface, the Wanderer differs totally from all our other butterflies. Dark brown and fulvous are the only colors above, and occupy a nearly equal space; on the hind wings they are divided about equally between a brown front and a fulvous hind patch, but on the fore wings it is the disk which is fulvous, while the brown forms an exceedingly irregular margin around it, in one place nearly or quite dividing the fulvous patch into two. Beneath, the hind wings are prettily mottled.

The latitudinal distribution of this butterfly is greater than that of any other of our Coppers. I have myself taken it in Sudbury, Ont., northern New Hampshire, and northern Florida, and it ranges northward to Nova Scotia and Quebec at least, and has been taken in southern Louisiana. Its western distribution is little known, for though it is taken everywhere east of the Alleghanies, it was until recent years hardly known west of them. It is reported, however, from Texas, from eastern Kansas, the Mississippi valley, and the Rocky Mountains. In New England it occurs everywhere, from the heart of the White Mountains and Aroostook County, Me., to the sea and

Long Island Sound. It has been taken in the Adirondacks of New York to the height of 1240 feet above the sea.

It is found only in the neighborhood of water where alder grows, and is most frequently seen where roads cross some little alder-lined stream, or are carried by an embankment over marshy ground fringed with alder bushes. It is consequently a very local insect, and apparently rarely wanders more than a few rods from its birthplace. It seems never to be found about flowers, but may sometimes be seen alighted upon the upper surface of a leaf, or more commonly upon a branch of alder among the woolly plant lice, enjoying with the ants the honey exuding from their bodies.

The eggs are laid by the female close by or among the clusters of these aphides, the butterfly running all over them with a twitching walk, somewhat like that of a wasp. By brushing away a colony of these plant lice the eggs may be found, generally attached to the under surface of the twig. They are covered during deposition with a thin albuminous deposit, rendering it difficult to get any proper view of their texture. They are flattened spheroidal in shape, faint green in color, and are remarkable for the great number of cells which cover the surface, and the slightness of their bounding walls, making them appear finely reticulated.

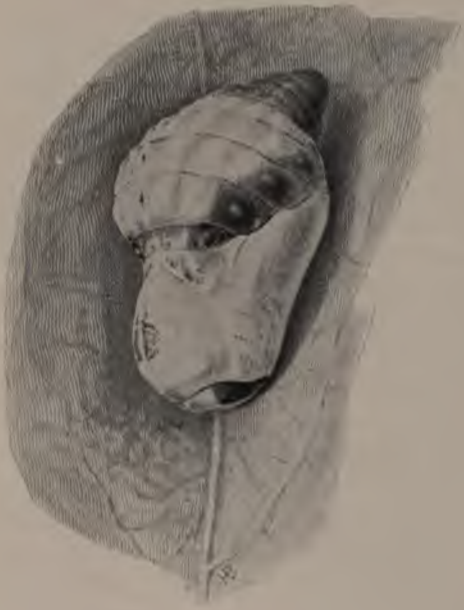
The reason for this choice of place for oviposition brings out the most interesting feature in this insect, the carnivorous character of the caterpillar, which is nourished solely by feeding upon plant lice, those being chosen apparently which congregate in masses and exude a cottony secretion. Every one in driving in the country must have noticed these white patches upon the alders, looking at a little distance like a luxuriant mould. These are the feeding ground of the caterpillars of the Wanderer, which play havoc among them. They are, however, not confined to the aphides of the alder, but have also been found on other plant lice, found respectively on the ash, beech, and maple, and the list will no doubt be extended to others, as several are under suspicion.

Although caterpillars of butterflies may in time of hunger turn cannibal and devour their brethren (and especially is this the case in the family to which the Wanderer belongs) this is the only known case among our species of a truly carnivorous butterfly, and it is scarcely known in any part of the world, though there is good ground to suspect a few tropical butterflies of the Old World of a similar habit, as will appear later. The structure of the caterpillar of the Wanderer bears witness to this anomalous habit, departing in many points widely from that of its nearest allies. The mandibles are very small and armed with four very sharp claw-like teeth, while the maxillary palpi have assumed a tapering form like the legs, by which they are probably enabled to seize an aphis and draw it within reach of the mandibles, while the basal parts around the mouth form a sort of short tube for the passage of the fluids of the victim.

In escaping from the egg, the caterpillar eats its way through the summit: it does not devour the rest of the egg, but pushes at once under the fatted plant lice and begins to spin for itself a loose filmy web sufficient to keep from being trodden upon and to protect it at the time of a moult; such a web it keeps to live in during its whole life, though it may leave it, crawl naked on the limb, and remove its abode to another colony: the plant lice often get ensnared in the web and get eaten in consequence; all are seized and devoured, or rather sucked dry, from below, and the backs of the caterpillars will be found covered with the wool from the lice: when provender is scarce, they are eaten faster than others can crowd to take their place, and so the colony of plant lice looks as if roads were run through them where the caterpillar has ploughed its way.

When the stem supporting one of these colonies of plant lice with the caterpillars feasting in their midst is jarred, the latter, unless then closely protected by web, are very apt to curl and fall to the ground, apparently by intention: or they may drop by a thread for several inches and then regain their place, even though they are tolerably large and

PLATE VIII



CHRYSALIS OF FENISECA TARQUINIUS, MAGNIFIED

heavy, a very unusual thing for most butterfly caterpillars to do. Besides the protection this and the web afford, their hairs catch the wool of their devoured victims and renders them, even when moving freely about, not noticeably distinct from the aphid masses.

The greatest enemies of the caterpillars are the ants, attendant upon the aphides, who consider them, and justly, as poaching on their own rightful domain; they bite at them furiously when they see them, and that is probably one reason why the caterpillars do most of their work in concealment, for then the ants cannot get at them without disturbing their pet cows. I once stocked an alder on my grounds with aphides, so as to introduce a caterpillar and watch its procedure, but my efforts were thwarted by the attendant ants, who brought the caterpillar to grief.

The chrysalis is an odd-looking object, and the anterior half, with its bizarre markings, bears, when viewed somewhat laterally, head downward, a curious resemblance to a monkey's face, as seen in the picture (Plate VIII.). Curiously enough, a similar ape's face is seen in the chrysalis of an African butterfly of another genus not very closely related to Feniseca, and in an Indian species of the same Oriental genus. Now in these two cases also there is a strong probability that their larval food is plant lice. That three butterflies of two entirely different genera in widely different quarters of the globe should be carnivorous, and perhaps the only known instances of carnivores among butterflies, and that each by different markings, and a different sculpturing of the body, should so vividly call to resemblance, when in chrysalis, the leering face of a monkey is a most curious coincidence.

The localization, and consequent comparative rarity of this butterfly, with the rather recent nature of our knowledge of its habits, make its life history still a little obscure. Probably there are three broods in the northern, four in the middle, and five in the southern States. The winter is probably passed in chrysalis, but it is not impossible that it may also winter as a butterfly, for battered specimens have been taken on the wing very early in the year, before the complete unfolding of the leaves, and butterflies have been known to emerge from the chrysalis as late as the last of September.

The first brood of butterflies of the year appears in New England about the beginning of the last week of May, and continues upon the wing until after the middle of June. The second brood appears early in July, and becomes abundant by the middle of the month. Search at Granby, Mass., on July 28, brought to light only caterpillars in the second stage; a fresh butterfly and full-grown larva were taken by me as far north as Sudbury, Ont., — the northernmost recorded point, — on the 13th of July, showing that even there the second brood appears at this early date. Fresh specimens may still be found during the whole of July, and rubbed ones during August; a worn female was found ovipositing at Ottawa on August 2, and they continue upon the wing until the third brood appears, about the middle of August, from which time fresh specimens continue to come out until near the end of September. In the central region of its distribution there are probably four broods, for three have been recognized in West Virginia, one from about April 17 to May 5, corresponding well in season to the first of the north; the second from about June 14 to July 4, a rather short period, but comparing fairly well to the second of the north; and a third the last of July, which, compared with the history in the north and considering the longer season in the south, must indicate a fourth brood not yet observed. If this be the case, it is probable that there is an added brood in the extreme south, for Abbot early in the century recorded a caterpillar in Georgia as changing to chrysalis on the 14th of April, which indicates a parent on the wing in March, at the opening of spring, and so an entire brood's time in advance of West Virginia.

One of the remarkable things about this extraordinary butterfly is the rapidity of its transformations in the preparatory stages. The eggs hatch in three or four days, and the caterpillar not only undergoes only three moults, — one less than is common among butterfly caterpillars, — but makes these with extraordinary rapidity, so that in specified instances only thirteen days elapsed from deposition of egg to formation of chrysalis, a period unsurpassed in North American butterflies. The chrysalis hangs the normal length of time, from eight to eleven days. Comparing this exceptional brevity of the cycle with the ordinary intervals between the broods, the first two of which appear to be fairly distinct, and in no case to overlap, it would seem to follow of necessity that the butterfly does not lay eggs immediately after emerging, but waits long enough to make up for the heightened activities of her progeny. The precarious nature of the food supply, and the special danger from the ants already mentioned, sufficiently account for the rapid passage of these earlier stages of life.

SATYRODES EURYDICE — THE EYED BROWN

THIS is a pleasing butterfly of peculiar appearance from the softness of its coloring and the delicacy of its markings. The wings are rounded and ample, of a pale mouse-brown, their outer border marked with one or two delicately penciled lines, at some distance from which is a series of dark spots, blind above, ocellated beneath, preceded on the fore wings above by some paler clouds, and on both wings beneath by several distant, irregular, slender, dark, transverse streaks.

It is a northern butterfly. It has been taken as far south as Long Island, New Jersey, and Pennsylvania, and once in South Carolina, and is said to be excessively abundant in central Ohio and especially in the western prairies, although rare in the northern part of the State; westward it is seen in Michigan and central Iowa, and it is also reported from northern Illinois, Indiana, and Wisconsin. In the north it has been taken at Mingan Island off southern Labrador, and at Rupert's

Fort, on the east side of Hudson Bay, but it has not otherwise been reported from Labrador. It is also found about Quebec, Montreal, and Ottawa, and it has even been taken at Great Slave Lake and occurs in Nova Scotia, so that its northern range is pretty extended.

In New England it is not a very rare insect, especially in the northern and elevated parts. It has been taken to the eastward in Maine at Orono and on Mt. Desert Island. I recall no notice of its capture south of Massachusetts, where it has been taken in the Berkshire Hills, at various points in the Connecticut valley, and by many collectors about Boston, where, though not abundant, it is by no means rare. Farther north, in the latitude of the White Mountains, as well as in the Adirondacks of New York, it will be found extremely abundant by those who look for it in its proper haunts.

These are elevated, moist meadows, particularly those lying on hillsides, and it is so restricted to them that one may sometimes find it in a spot but a few acres in extent, and search in vain beyond. It would probably be found in considerable abundance where it is now considered rare, were it sought for in the proper stations.

The eggs are pale green, subspherical, and almost imperceptibly reticulated, and are laid singly on blades of grass, living or dead; they hatch in from seven to nine days. The newly hatched caterpillar has a well-rounded brown head, and pale, greenish-yellow body provided with eight rows of little tubercles each bearing a clubbed bristle. The head of the mature caterpillar is green, and crowned by a pair of very long, conical, red horns, and the other end of the body is furnished with a pair of similar appendages; the body is pilose and pale green, striped longitudinally with slender darker bands.

The food-plants of the caterpillars are the coarser grasses and sedges. To escape from the egg, the young caterpillars bite a channel through the egg-shell around the summit, forming a lid which they may lift up; but instead of then leaving the egg they frequently eat a second hole on one side and there make their escape; once out, they sometimes devour the whole shell, leaving nothing but the attached base. During their earlier life the caterpillars are exceedingly quiet, remaining on a single blade of grass near the tip, from the sides of which they eat long, irregular patches nearly or quite to the midrib, with very slow movements, as if they were not at all hungry. They continue thus until several days after their second moult, when they not only begin to eat more rapidly and abundantly, but wander restlessly about from blade to blade; they eat mostly or only by day. When moulting the horns of the new head are directed forward, lying flat upon the front beneath the old skin. When moving about, these horns are inclined forward at a considerable angle from the vertical; but when at rest, the head is bent beneath the body, so that the hinder edge of the horns is on a line with the dorsal surface of the body, which is then protected both in front and behind by projecting armor.

The chrysalis hangs by its tail, and is green, with buff, longitudinal ridges, and rather elongate, and with few projections or angles; it hangs for about nine days.

The insect is single-brooded and hibernates as a caterpillar nearly or quite full grown. The butterfly usually appears about the 7th of July, occasionally as early as the 1st or as late as the 15th, and there is one record of its appearance as far north as the White Mountains on June 29. Generally it is abundant by the middle of July; toward the end of the month it is much less common, as well as badly torn and rubbed (for it is a very delicate creature), but continues until after the middle of August, and is said to have been taken in Canada in September. The female lays her eggs the middle or last of July, perhaps also later. The first caterpillar which I obtained was hatched about the 1st of August, moulted first on the 14th, again on the 29th, and the last time (for the season) on September 14, after which it remained quiescent. Others obtained later were hatched between July 27 and August 5, and were very irregular in their growth, backward specimens changing to their third stage on September 1, and forward ones to their fourth on September 7.

The butterflies have a very feeble, delicate flight, dancing lazily hither and thither among the herbage, flying generally but two or three feet from the ground; yet when alarmed their movements are more powerful than one would suppose possible in an insect with wings of so delicate a texture.

Speaking of the flight of this butterfly prompts me to add that just as an ornithologist may often distinguish the group to which a bird belongs by some peculiarity of its flight, so an entomologist may often judge to what group a passing butterfly may belong by some special feature of its movement on the wing. Thus the present species would be quickly referred to the Satyrids by its indolent but dancing movement; the Skippers have gained their name by the nature of their flight, and may also be readily recognized by their bustling ways; while zigzag coursing over the fields characterizes the Swallowtails and the Yellows. In the other groups, the lightning-like flashes of the true Nymphalids, and the uncertain tremulous movements of the Lycænids, especially before alighting, are equally marked. The form of the wing has a great deal to do with the character of the flight. Those which sail on expanded wings always offer an exceptionally broad expanse; the most rapid flyers have always a pointed apex to the fore wings, the lengthening of this part giving them a greater leverage; and those which may double suddenly in their flight never have the costal margin of the fore wings straight. And since the special form of the wing is characteristic of groups of greater or less size, so between the members of such groups the manner of flying is extremely similar.

POLYGONIA FAUNUS — THE GREEN COMMA

All the other species of Polygonia discussed in this book are double-brooded, and at the same time dimorphic; but the present form is single-brooded, and is not dimorphic. It differs from the others by the greater apparent raggedness of the outer margins of the wings, and by the considerable amount of dark green fleckings on the under surface, particularly noticeable in the males, and on the outer half of the wings. The centre of the hind wings is adorned beneath with a silvery comma-like mark.

This butterfly is as characteristic of the Canadian fauna as *P. comma* is of the Alleghanian, but unlike that it ranges across the continent. In the high north it has been recorded from Great Slave Lake, Fort Simpson on Albany River, Lake Winnipeg, Hudson Bay, and Newfoundland, and extends from Newfoundland, the lower St. Lawrence, and Nova Scotia, to Vancouver, Washington, and Oregon. West of the Alleghanies, beside the regions mentioned, it has been taken in the United States in Michigan, Illinois, Iowa, and Nebraska, but seems to be less common than east of this range, down which it extends to some distance, single specimens having been taken even in West Virginia and Georgia, though it is very rare south of the Catskills.

In New England it is a special inhabitant of the hill country, and is rarely found excepting in the north, the southernmost localities from which it has been recorded being Williamstown, Leverett, and Warwick, Mass. In the valleys of the White Mountains it is exceedingly abundant, and is the butterfly oftenest seen in deep ravines and on mountain slopes below the subalpine region. More than any other species belonging to the mountain region, it mounts to the very summits of the highest peaks, and both male and female are often found there far above any point where the caterpillar feeds. In the valleys it affects higher levels than its congeners.

The eggs are grass-green, barrel-shaped, with from ten to thirteen sharp vertical ribs, higher above than below, and differ from those of the other species in being of equal height and breadth. They are laid upon the upper surface of leaves, generally near the edge. Apparently a female lays but a few in a day, always singly and far apart, as on dissection relatively few mature eggs may be found in the ovaries of any individual. The eggs hatch in a week.

The food-plants of the caterpillar, on which the eggs are laid, are principally black birch and willow, but alder, currant, and wild gooseberry are sometimes chosen. I am inclined to believe that black birch is the favorite, as I have found them a dozen different times upon it. When just hatched it has a dark green, rounded head and light green body, furnished with half a dozen rows of long bristles. When full grown it has a black head, surmounted by a pair of long, stout bristly spines, and a brownish-yellow body, with a large white patch on the hinder half in striking contrast to the rest, distinguishing it from the other species; it bears also seven longitudinal rows of conical elevations, each surmounted by a spine beset with delicate bristles. During its early life it has a peculiar banded appearance produced by the alternation of dark and light papillæ. To escape from the egg on the upper side of a leaf, the caterpillar eats only the crown of the egg and then crawls immediately to the under surface, where it spends the remainder of its days. Experimented on in captivity, I found that it would keep to the normally under side, even when the leaf was reversed to bring it uppermost, so that the different texture of the surface may have a special attraction for it, though an instinct for concealment would seem to have originally impelled its action. So far as I have seen, it lives openly, making no sort of nest in the open field; but on one occasion, in confinement, when about to change to the last larval stage, one spun a feeble thread, attaching three or four leaves, and drew them slightly together. A similar habit has been observed in other species of the genus.

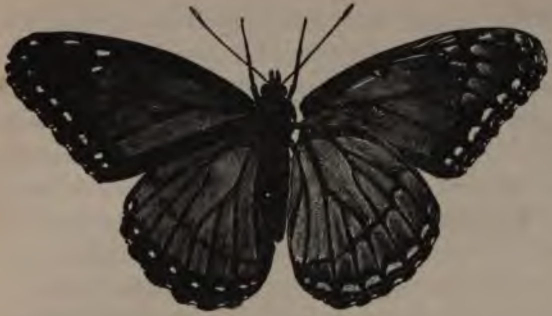
The chrysalis is angulated and tuberculated with a pair of frontal projections separated by a deep notch, and bears on the middle of the back of the thorax a high compressed nose; it is pale wood-brown in color, streaked with dusky green. It hangs by the tail for from eight to fifteen days.

Although the butterfly flies the entire summer, it is only single-brooded. It hibernates as a butterfly and appears in the early days of spring, April 15 being the earliest date on record. Visits to the White Mountains, where in New England it is the most common, are not made early enough to speak positively, but it must certainly be in flight there by the middle of May, and probably much earlier. In this same region, the hibernating butterflies continue to fly in considerable numbers until the end of June, may still be seen occasionally as late as the middle of July, and have been taken on the 18th. The eggs are laid there during the latter half of May and the whole of June, apparently in a very deliberate manner. These hatch in a week, the caterpillar takes about five weeks for its growth, the chrysalis hangs from eight to fifteen days, and fresh butterflies appear about the middle of July, before the old butterflies have wholly disappeared. July 14 is the earliest date noted there. A caterpillar, however, the earliest ever found, brought to a more southern latitude about Boston, was bred a butterfly on July 9, and butterflies have been raised in Montreal between July 3 and 6. It is generally not until toward the 20th of the month, or even later, that they become common in New Hampshire, but by the end of the month they swarm. Fresh individuals may be taken throughout the first half of August; they generally continue abundant throughout the month, and on pleasant days may be found on the wing in gradually diminishing numbers until the middle of October. No eggs whatever are laid by these butterflies during the season in which they are born, for repeated examinations have shown the eggs to be totally undeveloped in the ovaries. Before the end of October all have hibernated, probably in hollow trees, as their haunts are woodland roads.

Although very quick and active in its movements, this butterfly is not so shy as most species of the genus. It is readily captured, especially on the highways, where it loves to settle, with broadly spread wings, either upon the ground itself or upon twigs projecting toward the road from three to ten feet above the ground. It is much addicted to the droppings of horses, and has been found feeding upon this strange food "in a state of apparent intoxication, so as to be readily picked up by the fingers." It is seldom found far from the woods, although rarely detected within their depths, but rather in sunny openings, beside mountain torrents or in half-shaded forest roads. When captured and laid quietly on the ground, it will sometimes feign death by lying motionless upon its side; and when in the position of repose, with its wings back to back, will be seen to give a slight trembling vibration to the wings and antennæ, as if shivering from the cold!

Its ordinary flight is from three to ten feet above the ground, where it moves in a tolerably direct but slightly zigzag course, with intermittent movement of the wings; first, there are three or four rapid, vigorous flaps, then it sails a few feet, then the wing-beats are resumed, and so on. But if alarmed it will dash about in a headlong manner, abruptly terminating its flight by pitching suddenly on a tree trunk, or more commonly on a leaf of a projecting twig. At such a time it is as daring as it is impetuous, and even saucy, flaunting itself in your face and darting off again; or if a dash is made at it with the net, it will double and throw itself after the net. Starting up a pair just at my feet on the Mt. Washington carriage road one day, I stopped abruptly to see whether they would settle again. After flying a few yards away to escape the cause of their disturbance, one turned back and dashed straight at my face, turning only when within three or four inches of my nose, and then suddenly whisked off with a distinct click as it did so, snapping its fingers, as it were, in my very face.

There was no sort of doubt about this click, though if it had not been made so close at hand it would probably not have been heard. But other butterflies in the tropics have long been known to emit sounds like this, which can be heard at a considerable distance; others, including some of our own butterflies, are known to produce a rustling sound by the rubbing of one wing upon another; and movements of one sort and another have been so often observed, as of the opposite rubbing of the erect wings in most Lycænids, and the tremulous agitation of the wings in many different sorts when excited, as to leave little doubt that sounds made by themselves and for the advantage or warning of their brethren play a not unimportant part in the lives of butterflies. I have discussed this topic at length in my "Frail Children of the Air."



BASILARCHIA ARCHIPPUS — THE VICEROY

THIS well-known and most interesting butterfly differs totally in color from the other species of the genus to which it belongs, its ground-color being orange instead of blue-black. It is also more widely distributed than any of them, being found over nearly the whole of the United States as far west as the Sierra Nevadas, and in the north has been found, sparingly, even to the Pacific coast. It is rare in the extreme west, and I have not noticed its occurrence in Colorado, Arizona, or New Mexico, though it has been taken in southwestern Wyoming, central Utah, and western Nevada. To the south it appears to reach the Gulf of Mexico, though how far it penetrates the peninsula of Florida I do not know. The northernmost localities from which it has been reported are Crow's Nest and Calgary in the Northwest Territory and Hudson Bay. Farther east it has been taken on the St. Lawrence nearly to Quebec, and it is found in Nova Scotia. In

New England it occurs abundantly in the south and more sparingly in the north, although it is found in the very heart of the White Mountains.

In New England it is at least double-brooded, and it is more than likely that it is triple-brooded in southern stations, and probable that a third supplementary brood will be found everywhere. Its habits are very similar to those of the other species of the genus already described. It starts the year in its larval hibernaculum as a caterpillar ordinarily in its second stage, but not at all infrequently in its first, and rarely in its third stage. To escape from its narrow winter quarters, it must retreat backwards, and when it does this it is to find only the bursting catkins, and as yet no leaves of its foodplant; upon these it breaks its long fast, and even sometimes attains half its growth, but in May becomes full fed upon the tender leaves. The butterflies appear early in June, usually by the 5th or 6th in the latitude of Boston, the earliest date recorded being May 31. They rarely become abundant before the middle of June, and continue to emerge from the chrysalis until the end of the month. Pairing takes place at once, and eggs are laid in about a fortnight after the first appearance of butterflies, the earliest known to me being indicated by caterpillars found in the first stage on June 26, when the butterflies that season had been flying about three weeks. In northern New England they ordinarily appear about a week or ten days later than about Boston.

There is apparently no little difference in the rapidity with which the transformations are made, the eggs alone varying from four to eight days, but although the caterpillar is sluggish and by no means, as many are, a gluttonous beast, the transformations at this season take just about one month, and the second brood of butterflies makes its appearance in Massachusetts by about the middle of July, after seven to ten days in chrysalis. It sometimes appears as early as the 10th of July, flying, therefore, for a fortnight or more in company with many individuals of the first brood, and continuing to emerge from the chrysalis during the whole of July, and certainly a part of August. The first and second brood commingling, and the females of the second being ready to lay their eggs by the time the females of the first have closed their labors, the butterfly may be found in almost or quite every stage throughout July and August. This renders the precise time of the appearance of a third brood uncertain. That there is such a brood, the sight of plenty of fresh females laying their first eggs (as proved by their abundance in the abdomen) at the very end of August and early in September clearly shows; for if the third brood, undergoing its transformations in the hottest season, follows only as rapidly on the second as the second on the first, the first butterflies of this brood should appear early in August and be ready to lay eggs by the middle of the month; good specimens, fit for the cabinet, may still be obtained in the second week of September, and egg-laying continues at least into the third week, and probably throughout the month.

In the White Mountain district, the second brood is usually not seen until near the end of July; and thereafter, as further south, fresh specimens may be found the rest of the season, or until at least the middle of August. The earliest butterflies of this brood may in some years be able to lay eggs by the first week in August, and a third brood, or a fragment of one — a supplementary brood — appear early in September; whether there would then be time for the development of the eggs within and without the body of the parent, and the growth of the caterpillar past its first moult (the latter only a couple of days), may perhaps be questioned, but in favorable seasons and in protected localities in the lower levels it seems in no way impossible. Butterflies may be found throughout September, and I have found plenty of eggs and caterpillars in their earliest stages as late as the 7th of the month at Plymouth, N. H.

In the southern States the number of broods must be greater; they fly as early as the latter half of March, and become numerous early in April in northern Florida; they appear again in the latter half of May and early in June, and there must be three broods after that. The mode of passing the winter appears to be the same in the south as in the north, only that in West Virginia the caterpillar is said to reach always the second and sometimes the third stage before hibernation, which is sometimes deferred until near the middle of October. It is a curious thing that we find in the caterpillars of the first brood no tendency whatever to construct hibernacula; the instinct, then, is inherited by alternate generations, or acts only when the nightly chills or the desiccating food indicate the coming of an unfriendly season.

The early stages of this insect are so like those of the other species of the genus that they do not require special mention. The butterfly always chooses the terminal leaves of a twig for the deposit of her eggs, and even the tip of the leaf. They are usually laid on the upper surface, and it is very rare to find more than a single egg on a leaf; out of twenty-two collected in one day, five were found on the lower, the others on the upper surface. The duration of the egg state, as already remarked, varies from four to eight days; of two laid within five minutes of each other on August 4, at noon, and kept together, one hatched at nine o'clock in the morning of the 8th, the other in the night of the 10th.

Willow and poplar form the favorite food-plants, especially the former, and it has been found on many species of each. On hatching, the caterpillar eats its way out of one side of the egg, leaving the summit intact, but under natural conditions devours the shell to the very base before attacking the leaf. It now eats first the apical leaves and then those next in order, omitting none in its passage down the stem, so that its position on the defoliated twig may at once be determined. It is solitary in its habits, though several specimens may sometimes be found on the same bush. It moves about, particularly in early life, with a spasmodic motion, and when disturbed snaps its head upward repeatedly.

I once rested a leaf, on which a caterpillar had just changed its skin for the first time, upon another in such a way that the eaten tip (midrib only) of the first just touched the last; the caterpillar, which was eating its old skin with its tail toward the tip of the leaf, seemed to become aware of this, and showed unmistakable signs of temper, lashing its head to one side and the other, dashing it while doing so against the leaf, and finally arching the front of its body and remaining immovable, as if moody. It was a long while before it would resume its semi-cannibalistic feast.

In the same way, when touched by another caterpillar it goes into a fury of rage, throwing the whole front half of its body violently to one side and the other, and then causing the head to tremble vertically. If two, walking toward each other, meet and touch, the effect is ludicrous in the extreme, as they stand and swing their heads about, often striking each other violently in the operation. This is done at least as soon as after the first moult. Later in life it manifests its displeasure by moving its head in a circle around the leaf on which it rests, accompanying the movement by little spasmodic recoiling starts, making the leaf tremble.

Under natural circumstances, the caterpillar appears to feed almost entirely by night, for during the day one almost invariably finds it taking its siesta, while shortly after dark it is usually found either feeding or moving toward its feeding-place; but in confinement it will feed quite as much by day as by night. It never remains upon its feeding ground when its appetite is satiated, but retires either to the untouched midrib of the leaf where the sides have been eaten away or, when larger, to a twig. In either case it stops when it has reached its favorite spot and rests immovable, heading away from its food; appetite returning, it wheels about, hurries to its old feeding spot, and its meal finished, retires again to its accustomed station for a new siesta.

The habit of making a hibernaculum in the autumn in preparation for the long winter is precisely the same as in the allied species, and need not be described again.

The butterfly is found in open country in fields and meadows, especially in low grounds, wandering more widely than the other species of the genus. It is fond of the blossoms of the goldenrod, which harmonize well with its colors, and of the juices of apples drying in the sun, as well as of any over ripe fruit. It has been seen to alight on leaves curled by plant lice and drink the sweets exuding from the caruncles of the aphides. Its flight is rather leisurely and sailing; it moves irregularly from place to place, occasionally returning to the same spots.

The most interesting fact about this butterfly is the extraordinary difference it presents in general appearance from the other species of the genus. In each of its earlier stages it is with difficulty to be distinguished from any of them; but when it becomes a butterfly the difference is most striking. The orange ground-tint which covers nearly the entire surface is totally at variance with the blue-black which prevails in the other species, and it is the more remarkable because it accords so strikingly with that of the Monarch, or Milkweed butterfly, *Anosia plexippus*, as to leave no doubt that it is a true though unconscious mimic of that species. The facts of mimicry among butterflies, where the mimicked are always forms in some way specially protected from attack, are so well known that they need not be dwelt upon here, but it may be well to point out in a general way how the change of coloration in the Viceroy may have been brought about. It seems to have resulted from a complete suffusion (and perfect transference to the upper surface as well) of the orange spots which are found only at the base and near the outer margin of the other species of the genus, and which are usually wholly distinct, or confluent only near the tip of the fore wings. In the pattern of the markings we find the nearest approach to the form *proserpina*, which, as a hybrid of the other two

New England species, may possibly indicate more clearly than either of them the form from which both were derived; at least the course of the transverse stripe of our present species which, though black, includes some white spots in the fore wings, and is interiorly margined with white on the under surface of the hind wings, more nearly accords with that of *proserpina* than with either of its parent species; this stripe on the hind wings finds no counterpart in Anosia; but on the fore wing, by its expansion toward the costal margin, and its inclosure there of some small white spots, heightens the resemblance to the apex of the wing in Anosia, further aided by the paleness of the marginal lunules in all the wings. Our butterfly is found over very nearly the same area as Anosia.

STRYMON TITUS — THE CORAL HAIRSTREAK

THE two sexes of this butterfly are quite different in appearance so far as the shape of the wings is concerned, those of the hind pair being broadly rounded in the female, but sharply bent at the anal angle in the male; in both they are destitute of the tails usually found in this group. It is the largest of our New England Hairstreaks, uniform dark brown above, scarcely paler below, where the wings are ornamented with a marginal row of red spots, nearly or quite obsolete on the fore wings, and with a slightly sinuous series of roundish black spots in the middle of the outer half of the wings.

It is found over a wide extent of country, crossing the continent in a broad belt which includes most of the United States. The southermost localities from which it has been reported are Georgia, Alabama, Missouri, Texas, New Mexico, and Arizona. In the north it occurs as far as the southern limits of the Canadian fauna and beyond, for it has been taken at Montreal, Ottawa, in the Adirondacks of New York, and even on the north shore of Lake Superior; while west of Lake Superior and east of the Rocky Mountains its northernmost known localities are Iowa, Minnesota, Manitoba, Dakota, Montana, Assiniboia, and Alberta. In the Rocky Mountain region it has been taken at several points in Colorado, besides New Mexico and Arizona (already mentioned), and in the Big Horn Mountains of Wyoming. West of the mountains it has been taken in northern Oregon and on Vancouver Island. In New England it is considered a rare insect, but has occasionally been found in considerable numbers, at least in the southern portions. It has never been taken in the White Mountain region.

The eggs are deep green, broadly domed, and thickly covered with raised prominences, and are laid singly. The only one I ever found was tucked into the angle made at the extreme tip of a wild cherry twig by the equal forking of two little shoots, which took the place of the terminal twig. The newly born caterpillar is of uniform diameter, with a black head and light brown body, covered with several rows of rather long but unequal spiculiferous hairs sweeping backward. When mature it is slug-shaped, with a minute black head and yellowish-green body, covered with fine short pile and a couple of rosy patches on the back. The chrysalis is compact and rounded, of a pale, glossy brown, sprinkled with darker dots.

The caterpillar feeds upon wild cherry and probably other rosaceous plants. In escaping from the egg it eats a circular hole through the top, large enough to crawl out easily, and at once makes its way to the half-opened leaves close at hand; here it eats minute circular or oblong holes on either surface of the leaf down to the opposite membrane of the leaf, which it does not pierce. The under surface is usually chosen, as indeed is almost necessary, as it hatches at a time when the leaves are not expanded, or only expanded a little, and in the first instance still remain with their normally upper halves closely appressed. Later, while still in its first stage, and the leaves have opened, the caterpillar occasionally resorts to the upper surface, and now, on whichever surface, ploughs short, irregular, jagged tracks through the parenchyma down to the opposite membrane, and even occasionally, at the very end of this stage, completely through the leaf. This stage occupies about ten days, and is passed entirely upon the leaf it first attacks. It should be noted that the hairs of the under side of the wild cherry leaf closely resemble the bristles of its own body at this stage. When about to moult for the first time, it bites away these hairs over a space large enough for it to get its whole body down to the floor of the leaf itself, and sits there and mopes till the time comes.

On disturbing a caterpillar past the first moult, it will thrust its head out to its fullest extent, attach a thread to the surface of the leaf, and then, arching its body, let go all hold by its legs or prolegs, and hang by the thread it has spun. By degrees it then lowers itself by lengthening the thread until it reaches the ground, where it remains motionless for a time, and then crawls away.

The butterfly passes the winter in the egg state, at least in the north. Abbot, in the early part of the century, speaks of the butterfly in Georgia as frequenting the flowers of the red bud, which blooms in the north long before the butterflies are on the wing; so that the history of the butterfly in the south may be quite different, and there may be more than one brood in the south, which is not the case in the north. In the north, the eggs hatch just as the foliage of the wild cherry begins to open, about the middle of May. The caterpillar does not reach maturity before the last of June, remains in the chrysalis twelve days or thereabouts, and first emerges from the chrysalis shortly before the middle of July. The period of its earliest abundance is the last of July and the first of August, the advent of the female being, it would seem, usually delayed until the 20th or 25th of July, although it has been reared as early as the 13th. It continues upon the wing until nearly the last of August, and doubtless lays its eggs throughout this month, and these remain unhatched until the following spring. Occasional specimens of the butterfly appear to have been taken at earlier dates than the above statement would presume, such as June 22 and July 9, near Albany, N. Y., and

July 3 near Boston, Mass. Abbot bred it May 5, in Georgia, after seventeen days in chrysalis.

The butterflies have a rapid, nimble flight, and are found in the most open places exposed to the fullest rays of the sun, but usually in the vicinity of thickets. They are very fond of flowers, and resort to them in companies, when they are easily captured; they are especially addicted to golden-rod, Jersey tea, milkweed, and thistle.

BRENTHIS BELLONA — THE MEADOW FRITILLARY

THIS is a northern butterfly (Plate IX., Fig. 3), the middle line of whose distribution follows the St. Lawrence, and which occurs as far south as Pennsylvania, New Jersey, and northern Ohio. It does not seem to be found so far east as Nova Scotia or even New Brunswick, but westward it extends to the Rocky Mountains, where it has been taken from the Middle Park of Colorado to Canada. Northward it extends to Great Slave Lake, Lake Winnipeg, and Hudson Bay. In New England it occurs everywhere, and is equally abundant in the White Mountains and about Boston, and I have taken it on Mt. Washington and at various points from Mt. Desert Island, Me., to the Berkshire Hills, in Massachusetts.

There is more than one brood in a season. The first brood is heralded in New England by the appearance of a few individuals between the 4th and 15th of May, but it rarely becomes common before the end of May. Occasionally, it has escaped the notice of all observers in a given locality until toward the end of May, but this is probably due to their not visiting the proper haunts of the species early enough; and as in certain years its and those which have come from the retarded caterpillars, seem to behave in a different way, the first feeding until they have passed two or three moults (to the lethargic period of the earlier generation) when they go into hibernation for the winter; while the caterpillars from the later eggs, laid by butterflies presumably from the retarded caterpillars, hibernate at once after leaving the egg. This difference in age of the hibernating caterpillars no doubt accounts, at least in part, for the length of time during which in the spring fresh butterflies make their appearance.

The phenomenon of lethargy in the caterpillars of the second brood has been observed only about Boston, but in caterpillars from eggs from other places, and on repeated occasions in different years. In both the first and second brood of butterflies there are many instances, as I have found by repeated examination, in which the eggs are not developed in the body of the mother until the butterfly has to all appearances been upon the wing for several weeks, and even apparently for more than a month; and it would appear from the condition of those in which eggs were found that when the eggs are not developed at birth, they do not develop in the body of the female until at or about the time of the appearance of the next subsequent brood of butterflies, so that one finds upon the wing and laying eggs, at the same time, individuals of the first and second, and of the second and third broods. It thus appears probable that a mixture of broods takes place in two distinct ways: first, by the commingling of fresh and worn egg-laying females upon the wing late in July and late in August, that is, belonging to the first and second, and second and third broods; and second, by lethargy on the part of the caterpillars of one brood by which the butterflies produced from them apparently form a part of the brood which regularly succeeds them in time. It should also be remarked that this butterfly is very much more common on the wing in September than in July and August; and it has appeared to me that the spring brood of butterflies is also more abundant than the midsummer brood; this state of things would naturally be brought about by the reinforcement of numbers in the later brood, and the possible robbery of the second through lethargy on the part of the caterpillars and the retention of the eggs in the ovaries by the butterflies.

The eggs of this butterfly are tall, sugar-loaf shaped, with twenty or more prominent vertical ribs, are dull olive-yellow, and are generally laid singly on the food-plant, though sometimes dropped loosely near violets while the female hovers in the air. The caterpillar when born has a black or blackish head, and dusky green body more or less banded obscurely with ferruginous and eight rows of long, tapering, clubbed, black bristles. When full grown the head is blackish-green, and the body purplish-black mottled with yellowish and with a broken, velvety, black stripe on each side, and armed with six rows of stout, fleshy, aculiferous processes, seated on fleshy, conical tubercles all of similar length. It feeds on violets, and on escaping from the egg devours a portion or the whole of the deserted shell. The caterpillar feeds singly and openly, but only at night, making no web and concealing itself by day about the roots of the herbage. The chrysalis is of very irregular shape, angulated, and with prominent tubercles, and of a dark, yellowish-brown color, with various irregular markings in silvery white and olivaceous.

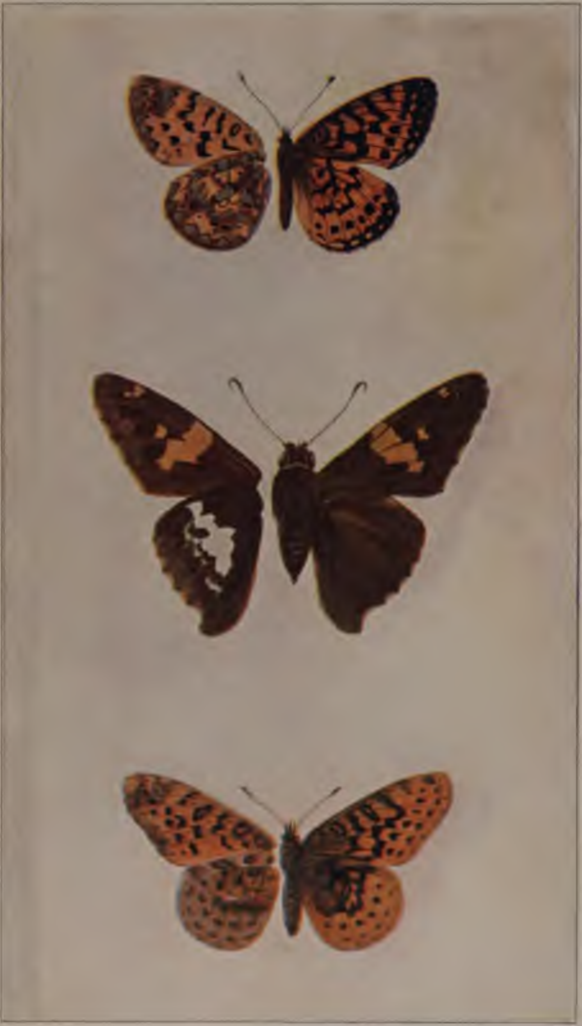
The butterfly is more or less local in its haunts, being found only about bogs and wet meadows, where it frequents the mint blossoms. It delights to bask in the sunshine, slowly opening and shutting its chequered wings, beating time, as it were, with its head, which is raised with the opening of its wings. It flies with moderate rapidity, fluttering in a waving, zigzag course about two or three feet above the ground, and is easily captured.

PLATE IX

1. Brenthis myrina

2. Epargyreus tityrus

3. Brenthis bellona



BRENTHIS MYRINA — THE SILVER-BORDERED FRITILLARY

THIS butterfly (Plate IX., Fig. 1) closely resembles the preceding, except upon the under side, where it is easily distinguished by the numerous lustrous silvery spots of the hind wings, reminding us of the larger Fritillaries of other genera. It is widely spread over the North American continent, where it occupies, east of the Mississippi, most of the Alleghanian and Canadian faunas. It is found as far east as Cape Breton and Nova Scotia, where it is one of the commonest butterflies. It is abundant along the Atlantic slope as far south as Maryland, and has even been taken in North Carolina; it occurs in northern but not in southern Illinois. Westward it has been found as far as Wisconsin and Iowa, and even Montana and Colorado. It has been reported as found in California, but this is emphatically denied by better authority, though one author credits it to British Columbia. In the north it is apparently found all over the settled parts of Canada proper, extending also to both shores of the lower St. Lawrence, to Hudson Bay, and the north shore of Lake Superior. Strangely it has not been reported at all from the great lake region of British America, north of 50° N. Lat., where one would expect to find it if it occurs in British Columbia; but it probably occurs there, as it is found at Fort Edmonton on the Saskatchewan, and even, though varying a little from the type, at Sitka, Alaska. In New England it occurs everywhere, and in nearly equal abundance.

The eggs are olivaceous-yellow, and tall, sugar-loaf shaped, with sixteen or seventeen prominent vertical ribs. They are laid upon the upper surface of violet leaves as well as on the stems, and I have also seen them laid in freedom on slender blades of grass in the vicinity of violets. Others have seen them dropped on the ground loosely by the hovering female. They hatch in six or seven days, though they sometimes take longer; some laid in July at Nepigon, Lake Superior, and carried to Massachusetts, required ten to twelve days; but in New England I have never known them to be delayed so long, excepting late in the season, when a fortnight is sometimes required.

The young caterpillar differs from that of the preceding species mainly in having a slenderer club at the tip of the bristles; and the mature caterpillar in having one pair of processes just behind the head twice as long as any of the others. It seems to feed quite indiscriminately upon all wild and cultivated violets. In escaping from the egg, it eats its way out of the upper half of the shell, but seldom devours the rest. By day it lies concealed upon a violet stalk or the under surface of a leaf, feeding only by night. When young it eats in little patches the parenchyma of the upper surface of the leaves; at a later period it bites holes entirely through them. It moves very slowly at first, but soon learns to wander about with great agility; it produces little silk, dropping quickly when disturbed, without spinning a thread. The chrysalis very closely resembles that of the preceding species, differing mainly in the relative size of some of the tubercles.

This insect, like the preceding, passes the winter as a caterpillar, sometimes just from the egg, sometimes when half grown. As a result of this difference in age, the first brood of butterflies straggles on in the spring, instead of bursting upon us in swarms, as is the case with many other of our butterflies. It usually appears toward the end of May, or somewhat later than the preceding species, but appears to vary somewhat with the latitude, and especially with the year. The earliest record I have seen is on the 16th of May at Albany, and it was said to be even then abundant. I have taken it there in another year a day later. It is reported on one occasion from as far north as Ottawa on the 22d, while the first specimens seen in their respective localities were found in other years at New Haven and Boston on the 24th, and about Boston on the 27th, 28th, and 30th (in different years). In two separate years it was first seen at London, Ont., on June 4, and in one year at Waterville, Me., it was not seen until June 12. Its usual appearance about Boston is in the early part of the last week in May, it becomes abundant early in June, and flies until the next brood of butterflies has made its appearance. Fresh specimens continue to emerge from the chrysalis throughout June, and in such northern regions as the White Mountains and in Maine early in July. The eggs are laid throughout the last half of June and during July, the earliest records being June 15 at Boston, June 16 at London, Ont., and June 20 at the Catskills. The eggs hatch in six or seven days, though sometimes delayed for nine or even ten days. The caterpillars feed for a month, and a new brood of butterflies appears in the latter part of July, rarely before the 19th or 20th (excepting in southern localities like Nantucket, where it occasionally appears as early as the third of the month, thus completely overlapping in time the later individuals of the brood a couple of hundred miles to the north), and becomes abundant at the end of the month, continuing to emerge from the chrysalis throughout a part of August, and being found still upon the wing in September, when the butterflies of the third brood have made their appearance, thus repeating the phenomena of the second brood. The eggs of this brood, being often laid immediately upon eclosion of the butterfly, may be found throughout the latter half of July and the early part of August; and being also found undeveloped in some until the butterfly has flown for some time, are also laid throughout the latter half of August and in September. Whether any or many of the caterpillars become lethargic when half grown is not known; none have been definitely observed to do so. The eggs of this brood hatch in from five to eight, generally seven, days. The chrysalis hangs from seven to eleven days, and the butterflies of the third brood may be found during September, rarely or occasionally at the extreme end of August. At this season there is also less difference in time between butterflies of northern and southern localities. Eggs of this brood are laid throughout September, and take from eight to fourteen days in hatching; the earliest caterpillars feed until partly grown (I have had them feed until October 18), and after the second moult pass into hibernation; the later-born caterpillars, as I have observed on several occasions with large numbers, hibernate at once after devouring their eggshells, refusing all other food.

In all the essential features of its history, therefore, the life of this butterfly is parallel to what we have found with the preceding species, excepting that the time of apparition of the different broods is a little later than in *B. bellona*, and no lethargy of the caterpillar has been certainly observed. The parallelism of the two cases is such that one can hardly doubt the existence of such lethargy, but it has never been detected. In some of the caterpillars of the second brood I have once or twice seen what I thought to be signs of it, but accident prevented confirmation. It should be bred on a considerable scale side by side with *B. bellona.*

The butterfly frequents low, moist meadows and roadsides in their vicinity. It is fond of settling upon flowers, — mint, whiteweed, and thistles. It flits lazily and aimlessly about, two or three feet above the ground, first making a few slight flutters, then sailing a short distance, and again resuming the motion of the wings.

THANAOS PERSIUS — PERSIUS'S DUSKY-WING

THIS modest butterfly resembles a small *Thanaos juvenalis*, which we have already discussed, but so far as it is known has a somewhat different distribution, and one much more extended, at least longitudinally. It is a common species in the north, but probably becomes much rarer further south. With the exception of a single locality in Texas it is not known west of the Atlantic seaboard in the southern part of the United States, but in the northern part, where it reaches nearly or quite to the Dominion of Canada, it extends across the entire continent. It is found throughout our entire Pacific coast, and in the western part of its range has occurred in Washington, Montana, Dakota, the Lake of the Woods, and Wisconsin. It has also been taken in the interior, from New Mexico and Arizona through Colorado to the Yellowstone. East of this its latitudinal range is at once diminished, so far as we have information, for west of the Alleghanies it has not been reported south of northern Illinois. Along the Atlantic seaboard, however, it extends to Florida. The northernmost localities in the east are the lower St. Lawrence, Ottawa, and Toronto. In New England it is everywhere pretty common, from Moosehead Lake and the valleys of the White Mountains to southern Connecticut and Nantucket.

The eggs are yellowish-green, subspherical, with a broad base and from eleven to fourteen rather high and stout vertical ribs, and change as they mature to a blood-red color. They are laid singly on the upper surface of leaves, the young and tender terminal leaves being nearly always chosen and the egg deposited near the middle of one side, invariably away from the edge; in one instance I found an egg laid on the young shoot itself; young trees also, and especially suckers, are preferred. They hatch in about a week.

The young caterpillar has at birth a black head and a pale green body, armed with eight longitudinal series of rather short apically expanded bristles. When full grown the head is generally ferruginous and the body plump, pale green, and briefly pilose. Its food-plants are willows and poplars, but it has also been found on Trifolium.

On emerging from the egg, the caterpillar eats only the crown of its late habitation, generally leaving the harder ribs sticking up as points, and at once quits the leaf on which it was born and seeks another close at hand; at least this is generally the case when it finds itself on willow; on poplar it appears to be less particular. It at once constructs a nest, usually, in this its first stage, by folding a cut flap of the leaf over upon the under side, later invariably upon the upper side. The caterpillar seems to wish to live near the middle of the leaf, for the flap is, in the first instance, generally bitten out of the very middle of the leaf, near the midrib, including no part of the edge, and is usually of a very short, tolerably regular, oval shape not more than five millimeters in diameter or twice its own length. Subsequently one of double that diameter is made, bent over upon the upper surface of the leaf so as to cover a spot near the midrib, and attached by pretty long and distant shrouds to the surface of the leaf and the midrib; it is made by biting a narrow and curved or bent channel inward from the edge of the leaf. Here it takes up its abode, back downward, and rarely if ever ventures from home, except under cover of the darkness; of the hundreds that I have collected, I do not recall seeing one out of its nest during daylight.

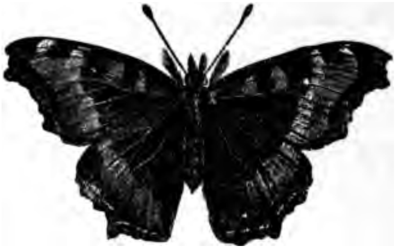
In its first larval stage the caterpillar eats the surface of the leaf only, whether of the upper or under side, and in the case of *Populus grandidentata* leaves untouched even the finest harder parts of the reticulation, eating between the meshes. When half grown, its mode of foraging is peculiar, and a ready means of detecting the presence of the caterpillar when its nest is beneath the leaf: it eats irregular little holes upon either side of its nest, always preferring the upper surface and leaving the nest intact, and these holes are scattered over the leaf, making it look as if it had received a charge of small shot or rather of angular pebbles; the holes sometimes become irregular, ragged slits. It is a slow grower; it remains about ten days in its first stage, and it is six or seven weeks after hatching before the last moult is past. After it has become half grown, and perhaps sooner, it always rests in its nest with its head bent at right angles to its body.

The insect winters as a full-grown caterpillar, and changes to a dull green chrysalis before vegetation has started. The butterfly appears on warm sunny hillsides early in May, usually during the first week, the females about ten days later than the males; fresh specimens continue to appear until nearly the end of the month, and the insect remains upon the wing, even in the southernmost parts of New England, until at least the middle of June, and farther north much later, for good specimens are common at the White Mountains in the third week of this month, and I have taken it in the Berkshire Hills on the last day of June. It appears also at just about the same season in central California and in Colorado.

The eggs of this brood appear to be rarely laid before the end of the first week of June, but by the middle of the month they are found in abundance and the young caterpillars begin to appear. Eggs may still be found until the very end of June, and thereafter, throughout the season, the caterpillars. These, as I have said, are very slow growers, but it appears probable that some of the earliest may go forward with relative rapidity to chrysalis and imago the same year, for there are some scant records of a second brood. Thus several captures have been made near Boston of fresh specimens in the latter half of July, and others, not so fresh and possibly not of this species, in August, and I have seen specimens from Colorado taken toward the middle of July.

But if this second brood exists (and it is on account of it that I have placed this species in its position in the present work) it would seem to be an exceptional thing, for I have carried the earliest caterpillars I could find — and they are very easily discovered — through the summer under the favorable conditions of the house, unexposed to the weather, and never found any sign of acceleration; on the contrary all alike reached their last stage during July. It was not until July 17 that the fattest had become full grown and closed its nest, as their fashion is, for the winter; the next did not do so until August 1; the others during this month, mostly before the 20th, the last by September 1. Here they remained, promptly sealing up every opening my curiosity made, until nearly the middle of October, when they were placed for the winter in a cold-storage chamber and not released until May 10. All were found still caterpillars and still active. As before, they resisted all attempts at inspection, so that I could only determine that half were chrysalids, half caterpillars on May 27; the first butterfly appeared June 13, just at its proper season, after at least sixteen days in chrysalis.

The butterfly is fond of alighting on wet sand, and may most frequently be found by shady roadsides near woods, seeming to frequent the vicinity of hazel. It is fond of flowers, and I have seen a specimen having the pollinia of an orchid attached one to each of its eyes — the only naked parts of the body where they would stick, unless it were the tongue. It flies with a strong, rapid movement, especially when disturbed, and seldom passes from one spot to an adjacent one without describing several irregular, rapid circles; at such a time it rarely rises more than two or three inches above the ground; just before alighting, the wings have a quivering motion. It is an uneasy insect, difficult to suit; no sooner alighted on a choice bit of moist, shady ground than off it starts again; and, in alarm, shows the greatest perturbation. It usually rests on the ground with the wings fully expanded, touching the earth behind, but considerably elevated in front. One may sometimes see it alight with expanded wings in the bright sunshine, and then, as if it were too hot for them, raise all of them equally till they are nearly edgewise to the sun. If it alights on a twig, the wings are usually opened so as to be at about right angles with each other. Each group of butterflies has its own trick of posturing.



AGLAIS MILBERTI — THE AMERICAN TORTOISE-SHELL

ANY one who has seen this butterfly will recognize it from our figure, for it differs markedly from every other of our butterflies. Although a northern insect, there are three broods annually, both the butterflies and the chrysalids hibernating. The former make their appearance by the middle of March, while the snow is still upon the ground; and where *Euvanessa antiopa* is found but rarely, as in Newfoundland, it is the earliest butterfly on the wing. The chrysalids disclose their butterflies early in April, and both new and old continue on the wing until nearly the end of May, at the White Mountains until June. They lay their eggs late in April and in May, and the caterpillars from them begin to change to chrysalids in the first half of June; after passing from ten to twelve days in this state, the first brood of butterflies from chrysalids of the same year makes its appearance, say about the middle of June, and becomes abundant by the 21st, at least in the southern portion of its range. The butterflies continue on the wing until after the middle of July; the eggs are laid very soon after the eclosion of the butterfly, caterpillars may be found during July, and after the usual period in the chrysalis state, sometimes shortened to five or even four days, the second brood of butterflies appears. This is at the very end of July, or sometimes very early in August, and the butterflies continue to emerge until at least the middle of August. These must lay their eggs at once, for the caterpillars are full grown at the end of August, and appear as butterflies early in September, before those of the previous brood have disappeared; from which one might easily infer that there are only two broods, the second prolonged by the dilatoriness of some butterflies in laying their eggs; but this hardly appears to be the case. A portion of the chrysalids of the last brood remain over winter, and some give birth to the butterfly as late as the first week in October. The butterfly may occasionally be found on the wing even to the middle of November. It hibernates under stones found in piles, or in barn lofts or similar places.

The butterfly is found most abundant by the roadside, especially among the hills and by the margin of forests. It has a rapid, lively flight, and is rather wary, easiest taken when settled with expanded wings in the road. It is always found in sunny exposures, is fond of resting in the spring on the dry leaves upon the ground, and is attracted by the lilac blossoms.

At noon one June day I noticed two females endeavoring to lay eggs on a patch of nettles by the roadside, though they were often disturbed by passers-by. One alighted a great many times and felt around with her abdomen, always on the under surface of the leaves, but apparently without satisfaction. Finally she stopped longer than usual on a leaf about two inches long with its edges still together, and which was second or third from the top of a stalk; after she left I found two large superposed bunches of eggs, four or five hundred in all, which she had not then had time to lay, showing that other females had found this leaf attractive. Search for eggs at other times with easy success showed that leaves are generally chosen rather above the middle of the upper half of the plant, but not at the extreme summit. The eggs are usually laid with no regularity, in confused heaps of about three or four layers, and an enormous number must be laid by single individuals. I counted 713 in one patch, and estimated that another must have contained 900. Several times I have found two or more patches on the same leaf; sometimes, however, they are laid in a single layer, spread widely over the leaf, and they have been found loosely scattered over a leaf in other cases. They are usually laid near the middle of the leaf, and generally on one side only of the midrib. Even when heaped, the eggs usually have a general upright position, especially those in contact with the leaf, but in reality take a good many directions;

adjacent ones, however, lie much in the same way, and some of those on top may lie upon their sides. The eggs are very tough and elastic, and adhere strongly to one another. They are barrel-shaped, as broad as high, with nine or ten thin and high vertical ribs, and pale grass-green; they hatch in about six days.

The young caterpillars have a dark olive head and pale-green almost colorless body, with several rows of long black bristles. The full-grown caterpillars have a black head and a spiny body, dark above, specked with white, so as to give them a snuff-gray appearance, and greenish-yellow below, all the spines black and covered with spinules. Their food, as may have been surmised from the place chosen for the eggs, is nettle. On escaping from the egg, the young creatures do not stop to devour them in the least, but after eating a portion or the whole of the leaf on which they are born, climb to the summit of the plant by weaving a silken path, to which each in its turn adds; within a day they smear the whole summit with a web and may be seen swarming, for they are highly gregarious in early life, upon the dried curved projections of the leaves, upon which they soon fasten themselves for a moult. They feed crowded side by side, and on the least disturbance raise their heads and front part of the body at right angles to the rest and wag them slowly in concert, producing a ludicrous effect, perhaps terrifying to their enemies. They are generally found on the upper surface of the leaf, and until half grown make no attempt whatever at concealment. After the third moult, when they have attained half their size, they quit these webs, and scatter over the neighboring plants, living singly or in small companies of three or four, leaving their deserted homes mere leafless stalks covered with web, in which are entangled the excrement and sloughed skins of their youth.

At this time they occasionally collect together in larger or smaller numbers, in incompletely closed leaves of nettle, but they leave the nest to feed in the most exposed manner. These nests are thoroughly closed next the base of the leaf, the edges having been closely drawn together with silk along the basal half of the leaf; to effect which, an irregular, triangular notch is eaten close to the base, cutting through one or both of the lateral ribs which spring from the very base of the leaf, leaving two considerable flaps which are fastened beneath the stem by their tips, thus bending the leaf at a strong angle between the deepest parts of the notches; the edges of the notch are then united, closing completely the pocketed or canopied base of the leaf; the opposite extremity, however, flares completely open, but by the bend in the leaf is hidden from view above. I have never found any of these leaf-nests the apical third or half of which was not eaten, so that I suspect an eaten leaf is chosen at the start. The caterpillars are sometimes so abundant in certain places that the nettles by the roadside fairly swarm with them. When young they do not bear confinement well.

The chrysalis is pale brown, creased and flecked with darker colors; or it is pale golden-green with rusty wrinkles and marked with salmon and pallid tints; it is shaped like a miniature *Euvanessa antiopa.*

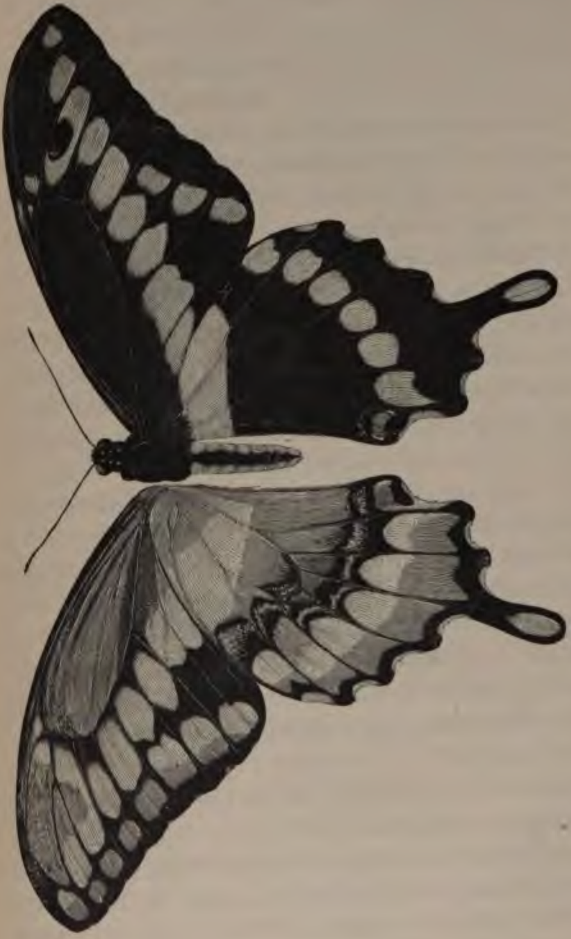
This characteristic Canadian butterfly is found across the continent. Eastward it occurs in Nova Scotia, Cape Breton, Newfoundland, and southern Labrador. On the Pacific slope it is found from Vancouver Island to central California. In the high north it is recorded from Great Slave Lake, Fort Simpson, the Athabasca region, and Hudson Bay. Southward it is occasionally seen as far as Long Island and about Philadelphia and in northern Ohio, while it has been brought from Colorado, New Mexico, and Arizona, following the mountain chains southward.

It is found almost throughout New England, but is extremely rare in the southern portions, the limit of its commonness being near the northern line of Massachusetts. Farther north it is very abundant, often the commonest species in its season, and is plentiful in the White Mountain region itself, flying to the highest summits.

HERACLIDES CRESPHONTES — THE ORANGE-DOG

THIS is our largest butterfly, and of a striking appearance from its contrasted colors, which are fully displayed in its somewhat majestic and dignified flight, wherein the deep black ground of the upper surface, and the saffron hue of the under surface of the wings are alternately brought into view. The upper surface is crossed by two very bold, broad bands, or subcontinuous series of large spots of bright yellow, which add to the conspicuous appearance of the butterfly, and a similar spot occurs at the end of the large spatulate tails.

It is, strictly speaking, an inhabitant of the tropics; but east of the Great Plains it is entirely at home in all our southern States, and has invaded, especially in recent years, many of our northern States. It is found throughout the Antilles, Mexico, and Central America, and through the northern part of South America, New Granada, Venezuela, and northern Brazil; and in all this region is accompanied by another form scarcely to be distinguished from it, which extends southward through the Amazon region to the tropic of Capricorn. In the United States it occurs in the greatest abundance in all the southern States south of latitude



35°, and has been known for a long while from many of the States farther north. It was recorded from New York as long ago as 1864; and it appears by the statistics of recent years that it has been slowly and steadily invading the north to a greater or less extent. It is now found fairly well established in all the States south of latitude 42°. It does not appear to have extended westward very far, being probably limited by the eastern border of the Great Plains. The westernmost localities from which it has been reported in the northern portion of the country are eastern Kansas, eastern Iowa, and Wisconsin, occasionally as far north as Lake Winnebago. This last indicates also one of the northernmost points from which it has been obtained in its western circuit, for in Illinois it has only been reported from Aledo, Galena, and Ottawa, and in Indiana from Greensburgh; but it has also been taken at several points in Michigan, and southern Ontario even as far as Toronto. In New York it has swarmed at Rochester, and is recorded from Brockport, Poughkeepsie, and Rhinebeck, as well as about New York city. It has even been seen within thirty miles of Montreal, at Chateaugay.

It has also extended far to the eastward along the coast. Apparently it became domesticated in southwestern New England about 1875, for in 1874 it was found in Westchester County, N. Y., and in 1875 a specimen was taken in New Haven. In 1877 it appeared in Fairfield County, and in that and succeeding years at Berlin, Conn. In 1880 it had established itself permanently in Poughkeepsie on the Hudson and probably in a considerable part of the southern coast of New England; for in 1882 it made further excursions, this being the year it was taken at Chateaugay, doubtless specimens which had followed up the Hudson-Champlain valley; while Massachusetts was invaded by way of the Connecticut and the seacoast, specimens being taken in July about Amherst and Boston. That they obtained a foothold in this section, if only a temporary one, is proved by the capture in the following year, 1883, of specimens at Worcester, Sharon, Cambridge, and Newton. But the most extraordinary case is their being seen by a competent observer, the late Mr. Henry Edwards, entomologist and actor, at Eastport, Me., in 1886.

Movements from the south northward in the nature of invasions are known by direct observation in only a comparatively few instances, but such movements are easily inferred from the sudden abundance of a locally unknown butterfly, or of one comparatively unknown, upon the southern shores of New England, indicating an attempt on the part of our southern butterflies to invade our territory, and if possible to establish themselves therein. Thus, *Chlorippe clyton* has on one or two occasions been found in considerable numbers in the immediate vicinity of New York, whereas its proper home is in the far south; an inhabitant of the middle States as well, it has on these occasions pushed its way to the north, but has not been able to maintain itself permanently, for it has never been seen within New England. So, too, *Junonia cœnia*, a southern butterfly which has apparently gained a tolerably secure foothold in southern Connecticut, has pushed its way along the warmer seacoast, so as to have been taken in a few instances even on the shores of New Hampshire, and of Maine as far as Bangor. *Euptoieta claudia*, similarly a permanent resident of our southern edge, has been taken in Massachusetts, both in the Connecticut valley and along the seaboard; and it has once or twice been found even as far as Portland, Me. A plainer case of invasion is seen in *Callidryas eubule*, which appeared on one occasion in immense numbers in Rhode Island, where it does not permanently dwell, and has been taken on several occasions upon Long Island and in Connecticut. *Xanthidia nicippe*, common enough in the south and even in the southern middle States, is ordinarily unknown in New England and New York; but in the year 1879 it must have made an extensive movement to the north, since near Newburgh, N. Y., it became more abundant than even *Eurymus philodice*, and was seen in eastern Massachusetts; there is but one other record of its occurrence in New England, in Norwich, Conn. Again, *Laertias philenor*, which maintains itself in small colonies in southern Connecticut and perhaps in eastern Massachusetts, occasionally appears in such numbers as plainly to indicate a northern movement of the throng that are found at no great distance in the middle States. There are many other instances which might be cited; these give a clue to the mode in which New England was originally colonized from the south after the ice age, and indicate that, whether or not the process is still going on, there is at least a constant fluctuation in the components of its butterfly fauna, or in the relative abundance of those types which maintain a precarious foothold from year to year.

But to return to Heraclides. There are said to be four broods of this butterfly in Florida between February and October; three in northern Texas, the caterpillars being found in April and May, July, and September and October; in both regions, as in the north, winter is spent in chrysalis. At the northern limit of its distribution, there are two broods, the butterflies appearing early in June or even in the last week of May, flying throughout June, and the second brood appearing again at the end of July; they evidently continue to emerge from the chrysalis throughout August, are laying eggs, to judge from the caterpillars found, at least throughout August, and fly throughout the greater part of September and even into October. The whole period from egg to imago in a single season may be as many as sixty or as few as twenty days.

The eggs are almost exactly spherical and without markings, being smeared with a thin coating, which conceals the surface. They are laid singly, usually upon the tender shoots and leaves. The ovaries of the female contain over five hundred eggs, the laying of which occupies many days, in which they are scattered over a wide area, seldom more than four or five being deposited on a single plant. They hatch in from four to twelve days.

The young caterpillar just from the egg is armed with exceptionally large and coarse fleshy tubercles, beset with numerous divergent clubbed bristles, so as to give the creature an unusually formidable aspect; but the same colorational contrasts between the different parts of the body are found as obtain in later life, the central and posterior parts of the body being white and the remainder brown. The mature caterpillars are naked and without tubercles, but swollen in advance of the middle, and in front ferruginous-brown with a lateral stripe, the hinder end of which, including two or three segments and a broad saddle in the middle, is cream-yellow flecked with brown; the markings are such as to bring the tumid portion into higher relief.

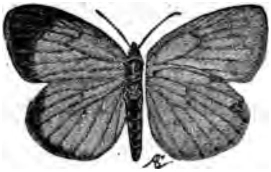
The caterpillars will probably feed upon any member of the rue family, as they have generally been found upon some one of that group, and especially on orange; but they have also been taken upon other plants of widely differing groups, as the tupelo, the red bay, and even the Lombardy poplar, and some of the peppers. When young they feed only upon the tenderest leaves, but when well grown demolish both the older leaves and such shoots as have not hardened into wood, sometimes doing much damage. They appear to feed only by day. When not feeding they remain rigidly motionless on the surface of leaves, and then, particularly when young, closely resemble the excrement of birds, which doubtless serves for their protection. When young they rest on the under side of leaves, and eat only the tenderer part between the veins; when partly grown they may also be found on the upper surface, and when still larger rest upon the branches or the leaf stem, and eat the entire leaf, except the midrib. The osmateria emit a very disagreeable odor. The caterpillar stage generally lasts about a month, but may be as short as twenty days.

One naturalist suggests as a means of keeping the insect in check where destructive the extraordinary device of shooting the butterflies with dust shot from a fowling piece, as they cluster about flowers! "An insect," he says, "which has a spread of four or five inches affords a by no means despicable object for target practice." Gunning for butterflies may yet be introduced into the list of southern sports.

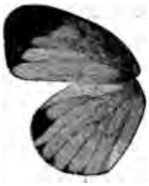
The caterpillar generally suspends itself upon the twigs or branches, occasionally on the leaves, of the tree that has nourished it. The chrysalids are rough and angular, and of a dead-leaf brown tinged with green. Wintering chrysalids particularly so closely resemble the color of the bark of the orange-tree as to be difficult to detect. "The irregular projections," says one writer, "and sundry markings resembling cracks in the bark, and even minute lichens growing upon it, bear out the striking likeness to a bit of knotty orange branch most perfectly." The summer chrysalids remain suspended for from six to sixteen days according to the season, ten to fourteen being the most common. The wintering chrysalids occasionally go over a second season!

The butterfly has a strong flight, being a vigorous insect with a steady stroke of wing, resembling that of some birds in its dignified movements. It has the habit of alighting on projecting twigs, and then the wings are fully expanded, with a slight droop.

The protective coloring of the caterpillar and chrysalis have been alluded to, as well as the odor from the stench-horns of the caterpillar. No bird attacks it, says one writer, though often exposed. "The shrike, that is almost omnivorous, will not touch it, nor will the bee martin, nor the mocking bird." Yet it has its parasitic foes, as well as other insect enemies.



Male



Female

EUREMA LISA — THE LITTLE SULPHUR

This butterfly has well-rounded wings and is canary-yellow above, broadly margined with blackish-brown, the bordering especially of the hind wings differing in the two sexes, as the figures show. Beneath, the ground-color is a duller yellow, sparsely sprinkled with brownish dots and ferruginous flecks, especially on the hind wings.

It is a characteristic butterfly of the southern States, where it is extremely abundant, and occurs from Atlantic to Pacific. Indeed it extends beyond our southern borders, for it is found in Cuba, Jamaica, and Porto Rico, as well as in Mexico and Honduras. North of Arizona and New Mexico, however, its western limits seem to be the Great Plains, for it has only been found as far as Kansas and Iowa. To the north it has been found as far as Wisconsin, northern Ohio, western New York, and southern Ontario, and about New York city. In New England it is found in abundance only in the extreme south, where it may be met with along the entire coast; it is also found up the Connecticut valley as far as central Massachusetts and along the eastern shore to Boston, and specimens have even been taken on the seacoast of New Hampshire and Maine.

It is also found in Bermuda, where very few insects are found. Whether it is there a permanent resident or not is uncertain, but twice at least great irruptions of this butterfly have been observed, clouds swept by the winds over the six hundred miles of ocean intervening between the islands and the mainland. One of these is thus described by Jones: "Early in the morning of the first day of October (1874) several persons living on the north side of the main island perceived, as they thought, a cloud coming over from the northwest, which drew nearer and nearer to the shore, on reaching which it divided into two parts, one of which went eastward and the other westward, gradually falling upon the land. They were not long in ascertaining that what they had taken for a cloud was an immense concourse of small yellow butterflies, which flitted about all the open grassy patches in a lazy manner, as if fatigued after their long voyage over the deep. Fishermen out near the reefs, some few miles to the north of the islands, very early that morning, stated that numbers of these insects fell upon their boats, literally covering them."

The eggs of this butterfly are very graceful objects, shaped much like a ninepin, and light green with numerous slight vertical ribs. They are laid singly on the stem or upper surface of the leaves of Cassia, that being the food-plant of the caterpillar, species with small and finely divided leaflets being apparently preferred. They hatch in five or six days.

The young caterpillar is a slender, cylindrical worm of a pale-green color, with eight longitudinal rows of conical elevations, each bearing a straight, erect, clubbed hair. The mature caterpillar is briefly pilose, grass-green, with a pallid line along the spiracles. After escaping from the egg by a hole eaten through one side, the little caterpillar generally continues to eat some of the shell it is leaving, and sometimes devours nearly the whole of it. From the very first it feeds on the under side of the leaves, and eats long, parallel, and narrow holes entirely through between the veinlets. As the leaflets of the food-plant close at night, this position would seem to be a necessary one, and also probably induces its habit of eating only by day. When not feeding, the caterpillar invariably stretches itself out at full length, either along the stalk of the plant or the middle rib of one of the leaflets, where being of the same color as it, and the stigmatal stripe resembling in its straightness and stiffness the midrib of the leaflets themselves, its detection is very difficult. When disturbed, it will raise the front portion of the body barely above the surface, and sway it from side to side in a slow and deprecatory manner; but if roughly handled, it will drop from the leaf, spinning a thread and hanging thereby.

The chrysalis is translucent green with a few black dots, a little compressed, and pointed at each extremity; it is attached by the tail and swung in a loop around the body.

The life history of this butterfly is somewhat obscure and puzzling. The principal difficulty is to understand how it passes the winter. In Florida it flies nearly the year around, from early in February to late in November. Early in the spring, however, the butterflies are so few in number, until the end of April, that one might take them all to be individuals which had passed the winter in the winged state; and the behavior of the insect in the north, and the probably similar habit in an ally, renders this the more probable. In May, at any rate, a new and fresh brood appears, and by the end of the month becomes numerous, and thereafter remains so for the season. Fresh material appears to arrive toward the end of July, and again from and after the middle of September, and very fresh specimens may still be obtained in Georgia to the end of October. This would give three broods a year, counting the spring butterflies as a part of the September-October brood, though certainly some of the specimens taken in March seem fresh enough.

North of Pennsylvania, or on the northern edge of its range, I cannot learn that the butterfly has ever been seen earlier in the spring than the middle of June. The brood which this marks flies only in very scanty numbers, and to the middle or end of July. Immediately thereafter, or early in August, generally from the 2d to the 5th, a new brood appears, which is much more numerous, sometimes tolerably common, and butterflies continue to emerge from the chrysalis, judging by the capture of perfectly fresh specimens, well into September, and to fly throughout the month. No October captures have been noted. The eggs are laid certainly as late as August 20, and I have had females with fully developed eggs, none of which had been laid, as late as September 9. The eggs hatch in about six days, and the caterpillars are full fed in about a month from the time when the eggs are laid. And now follows the strange part of the procedure at the north. All my chrysalids, one autumn, when I reared the insect in some numbers, which entered that state between September 17 and 22, and were kept in an unheated room adjoining a very large one heated only by an open wood fire, and where the windows were kept open night and day, gave out the butterfly; the first change of coloration was noticed between October 11 and 15, and in this condition of partial readiness they remained from seven to thirteen days, and finally the butterflies emerged after from thirty to thirty-eight days in the chrysalis. Of course this is not normal, but the conditions of temperature must have been very slightly different from what they would have had in the open air. This appears to me to be an attempt in the north to simulate the third brood in the south, but it scarcely seems possible that the earliest produce of the second brood can reach maturity in season out of doors to give birth to butterflies before such cold and frosty nights would come as would kill the newly emerged butterflies. Still it would appear that it is probably by this small chance of life that the butterfly maintains its foothold in the warmer nooks of New England.

The butterfly is found in the open country, in gardens, meadows, on the edge of thickets, and around spots of damp earth where it may suck up the moisture. Abbot, early in the century, made the quaint note, "It settles so many together at times to suck moist places that I have seen twenty in the compass of a hat." Its flight is much more vigorous than one would anticipate from its delicate appearance, but is after all feeble and timid. It flies but short distances at a time, close to the ground, but is to be found on the wing in the windiest and most heavily clouded weather.

Occasionally, at least in southern localities, and perhaps confined to the later broods, one finds females of a pallid appearance, in which the yellow of the upper surface, and to a certain extent of the under surface as well, is replaced by dull white, in short an albinic variety. This peculiarity it shares with many members of the Red Horn group, to which it belongs, in which pallid females are not uncommon. In some instances all the females are albinic ; in others only a portion of them, but not restricted in geographic range, so far as known, though in species having more than one brood they are relatively more frequent in later than in earlier broods. In one genus, Eurymus, it is far more common in the subarctic and subalpine species than in those found in lower levels or latitudes.

POLITES PECKIUS — THE YELLOW-SPOT

THIS very common but insignificant-looking butterfly (Plate II., Fig. 1) has wings of a dark brown color marked with tawny, especially noticeable in a transverse band across the outer part of the wings above, and in a conspicuous, large, and very irregular central patch on the under side of the hind wings. The male has in addition a dead-black arcuate dash in the middle of the fore wings.

It is widely spread over the northern States and Canada. The southernmost localities from which it is known are West Virginia, southern Ohio, Kentucky, and eastern Kansas, which State and Iowa and Wisconsin are as far west as it is known. It is found throughout all the older-settled parts of Canada, and as far north as the lower Saskatchewan and the southern shores of Hudson Bay, and east as Cape Breton and Nova Scotia. In New England it is everywhere the commonest of the smaller Skippers, and is found from the heart of the White Mountains to the seacoast.

It is double-brooded in the southern part of its range and single-brooded in the northern, the change occurring near the middle of New England. Localities which certainly belong to the district in which the butterfly is single-brooded are

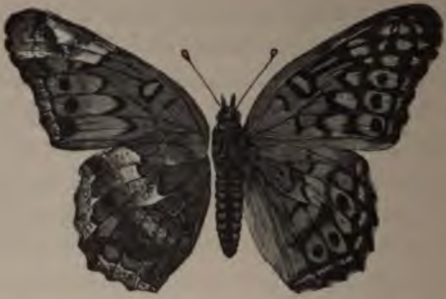
Waterville, Me., the White Mountains, Compton, just over the Vermont border, and London, Ont. Yet I am assured that a second, autumn brood occurs at Ottawa. In the opposite category are all Massachusetts localities, even Williamstown, high in the Berkshire Hills, and Albany, N. Y., with points to the south. In both, the winter is probably passed in the chrysalis state, though possibly in that of a mature caterpillar. In the northern area, where the insect is single-brooded, the butterfly appears the last of June or early in July, occasionally by the middle of June in the southernmost districts; it continues on the wing until after the middle of August, although by the beginning of the month it has begun to diminish greatly in numbers. It is not until the butterflies have been at least two or three weeks upon the wing that the female begins to deposit her eggs, which are hatched in from twelve to fifteen days. The young caterpillar is therefore seldom born before the end of July, and sometimes not until the end of August. Its future history has not been traced.

In the southern half of New England, where the species is double-brooded, the earliest generation of butterflies appears upon the wing during the last week of May, — at the beginning of the week near the southern seacoast, toward its middle or end farther north; both sexes become abundant in a week, and continue on the wing up to the middle, sometimes to the end of July, although often diminishing greatly in numbers during the latter half of June. The female deposits her eggs after the middle of June; these hatch in eleven or twelve days, but at what time the caterpillars attain maturity has not been shown. The second brood of butterflies, however, appears early in August, sometimes by the very first day, but perhaps more frequently (unless near the southern borders) by the 5th or 6th. In a few days it becomes abundant, and continuing to emerge from the chrysalis for two or three weeks, individuals remain upon the wing nearly or quite to the end of September. The history of their progeny has not been traced. Facts seem about equally to favor the view that they hibernate as chrysalids or as nearly mature caterpillars; probably the insect will not be found to differ in this respect in the northern and southern half of New England.

All the eggs that I have seen were laid by females imprisoned over grass and were laid loosely, quite unattached. Others have had the same experience. They are smooth, hemispherical, at first white with a greenish tinge, and as they mature are decorated with coarse red dendritic markings.

The caterpillar is born with a black head and plump white body, armed with long bristles arranged in longitudinal rows. Afterwards the bristles are lost, and the body is pilose and griseous from a multitude of dark dots on a pale brown ground. Several unsuccessful attempts to rear this caterpillar upon lawn grass have been made; probably some special grass or sedge would suit it better. It leads a gypsy life; it wanders incessantly from its youth up, and is uneasy at the least confinement; it makes a nest soon after its escape from the egg, but passes little of its time within it and soon abandons it for another. Its earliest nests are loosely constructed in a single blade of grass by uniting opposite edges with two or three threads; subsequently they are made of very few and slender threads stretched from blade to blade; all its nests are very delicate, at least until half grown, which is as far as we yet know it. It feeds both by day and by night, and is alarmed at the least motion, starting suddenly back into its nest with a movement quite unlike that of the other Skippers, and not venturing forth again for some time. When it moves about, its head trembles from side to side as if it were afflicted with palsy.

The butterfly is found everywhere in the open country, especially in meadows, by roadsides, along pathways, and in all old forest openings; it is very fond of flowers, — white clover, mint, goldenrod, etc. When alighted on a flower to feed, all the wings are sometimes tightly closed back to back; or both pairs are slightly and equally parted; at still other times the fore wings are opened at right angles to each other, while the hind wings are fully expanded. This last, a little exaggerated, is the position of repose upon a leaf.



EUPTOIETA CLAUDIA — THE VARIEGATED FRITILLARY

This southern butterfly is a little above the medium size, and the colors of the wings, which are black and fulvous above, fulvous, brown, and hoary beneath, are arranged in a somewhat complicated pattern, as our figure shows. It is unlike any of our other native species, and so is readily recognized.

It is found abundantly in the south in all the Gulf States, and is said to be found along the coast of the Gulf of Mexico and Caribbean Sea through Mexico, and as far as Honduras and Guatemala; certainly it occurs in northern Mexico. Westward in the United States it reaches the Rocky Mountain region and Arizona, occurring in New Mexico, Colorado, and Utah, as well as western Nebraska and the Big Horn Mountains. It even occurs in Alberta, north of our territory. It is very rare in the northern half of the United

States, but has been reported from Pennsylvania, New Jersey, New York, Ohio, northern Illinois, Wisconsin, Minnesota, and Iowa, and single examples have been taken even in northern Ohio, southern Ontario, and near Montreal. In New England it is therefore naturally a very rare insect, but it has been taken repeatedly in eastern Massachusetts, and even at Kittery and near Portland, Me.

The eggs, which are short, sugar-loaf shaped, with from thirty to forty distinct vertical ribs and pale green, are laid singly on the food-plant, and hatch in from five to twelve days.

The caterpillar is slender and cylindrical and when born has a dusky head and pale greenish brown body bearing half a dozen longitudinal rows of black bristles; when mature, the head is shining black with slight orange markings and a bright reddish-orange body, the skin glistening and adorned with a pair of black-edged white stripes on each side; there is a pair of long spines on the back of each segment, the first pair much longer than the others and clubbed at the tip. It feeds on various plants, but particularly on Passiflora and Sedum; Violaceæ do not come amiss to it, and when abundant it has even been known to injure pansies. It probably feeds by night, and by day resorts to stems of bushes and higher plants; it travels with great rapidity.

The chrysalids are rather stout but elongated, without prominences in front, though tuberculate on the back, the tubercles blunt, conical, and gilded or metallic bronze, while the body itself is black or dark brown with nacreous markings like mother-of-pearl, being more or less iridescent.

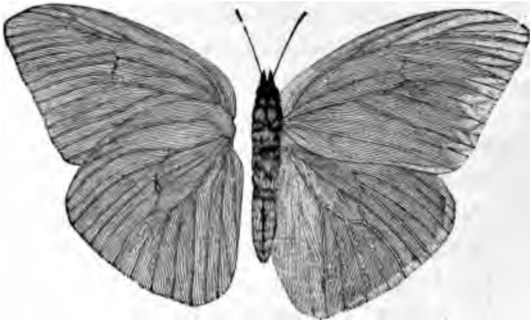
Its life history is imperfectly known and a little obscure. It is apparently triple-brooded. The first butterflies appear very early in the spring, the middle of February in Texas or the last of March in northern Florida. Whether these are hibernating individuals or fresh from wintering chrysalids is not clear, but in either case they probably belong to the same brood as those which appear late in the preceding autumn. In Georgia, caterpillars are full grown early in May, and after about eleven days spent in chrysalis, emerge as butterflies. A second brood seems to appear about the middle of July in Virginia and Tennessee, when the egg state lasts five days, the caterpillar grows to maturity in a fortnight, and the chrysalis hangs a week. A third brood — the only numerous one — appears in the middle of September, becomes abundant by the 1st of October, and in the extreme south certainly continues, although in diminished numbers, throughout most of November. It is possible, perhaps probable, that in the extreme south other broods are interpolated between these.

As to hibernation it seems probable that the butterfly often hibernates, and that some of the autumn chrysalids do not disclose their inmates until very early the following spring; and also that caterpillars hatched from eggs laid by the

October butterflies become lethargic and hibernate either as soon as born or partially grown, reviving in the following spring with the earliest vegetation, and developing so rapidly as to transform to the May butterflies. This would account for the scantiness of that brood.

In New England the few specimens captured have generally been taken in the first half of August, but fresh specimens have been found between July 17 and September 1. It would seem as if these were all members of a single brood. When fresh members of an early May or June brood are found, we may more confidently consider it really indigenous to eastern New England, that is, as living there winter as well as summer.

The butterfly is an insect of rapid flight, not far above the ground, and frequents fields and open places, especially lowlands, where it delights to sit on the dry sand of river banks, rising instantly if approached, when its movements are difficult to follow. It is partial to flowers and particularly sunflowers.

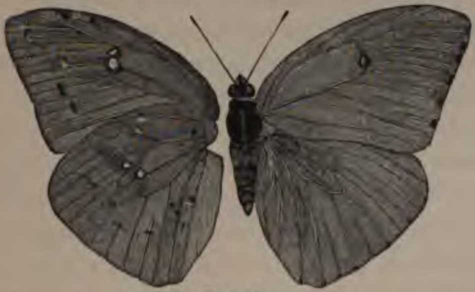


Male

CALLIDRYAS EUBULE — THE CLOUDLESS SULPHUR

THIS is our largest member of the subfamily of Red Horns, and in the male of a nearly uniform yellow above and below. The female is more or less flecked with ferruginous beneath, and has one or two central silvery spots, occurring in part in the male, but less conspicuously.

It is a southern butterfly, extending down the Atlantic coast to the Florida Keys and along the Gulf coast to Texas, and is found also in New Mexico, Arizona, and southern California. South of the United States it is found in Cuba and many of the other Antilles, as well as in Mexico and all parts of Central America, and in South America at least as far as Argentina and Chili, and is reported also from Patagonia — its northern part — and even from the Galapagos Islands. It sometimes occurs in considerable numbers in the Middle States, and even invades the northern States, having been reported from Long Island, New Jersey, Maryland, Pennsylvania, Ohio, Illinois, Kansas, Iowa, and Wisconsin. In New England it has only been found in a few places, mostly in the near neighborhood of Narragansett Bay, but also in Connecticut and on Cape Cod.



Female

The female lays her eggs singly, about one egg a minute in one case observed, selecting the more tender leaves of the food-plant, and affixing them erect, indifferently upon the upper or under surface of the leaflets. They are subfusiform, but much broader below than above, about twice as high as broad, with less than twenty slight vertical ribs, and of a yellowish color.

The caterpillars are long and slender, with a rather small head, of a yellowish-green, with a yellow stripe along the sides, and dotted with black points arranged transversely. They feed upon leguminous plants, with a decided preference for Cassia, on at least four different species of which they have been found.

The chrysalis is of an odd shape, compressed, and at the same time strongly curved backward, being dorsally concave, the wing-cases very large and protruding extraordinarily beneath in a strongly rounded ventral curve, while the anterior extremity is produced to a long, conical snout. The color is green, often striped with yellow.

The insect is probably double-brooded, both in the north and in the south. The second brood is much more abundant than the first, and the imago being long-lived, some individuals at least hibernate in the winged state. In Florida they are on the wing from the middle of February until almost the end of November. The first brood of fresh butterflies makes its appearance the last week of April, and the second early in August or even late in July, and continues in multiplied numbers throughout August and September. The eggs are laid at least until the middle of September; the chrysalis state at this season lasts ten or twelve days, and as fresh butterflies are found in Georgia up to the middle of November, it doubtless hibernates either as a caterpillar or as a butterfly, probably the latter. The same is probably true in the north, where the spring brood has not been noticed, and the autumn brood appears in the latter part of August. This is perhaps entirely made up of migrants from the south, for Rev. Howard Clark writes that the autumn he found them abundant in Rhode Island, they "were swarming about the brilliant cardinal flowers, and their numbers were constantly augmented by new arrivals, which all appeared to come from the south. Most of the specimens were considerably mutilated, and appeared to have been on the wing for a considerable time."

The male has a fragrant odor arising from the scales peculiar to the sex, which Miss Murtfeldt has likened to the odor of violets, but which Fritz Müller calls musk-like; it is retained several days after death. The butterfly is very fond of flowers, and is seen only in the blazing sunshine. Gosse once plucked in Alabama a spike of scarlet woodbine, and had it visited while in his hand by one of these butterflies which probed the tubular flowers with its long tongue; "so eager," says he, "was it to gratify its appetite that without any trouble I caught it in my fingers." It has a strong and rapid flight, though at times moving leisurely from flower to flower.

All southern observers have borne witness to the great numbers in which this showy butterfly congregates. Bates relates how on the banks of the Amazon patches of butterflies congregated on the moist sand, mostly of this genus, "in densely packed masses, sometimes two or three yards in circumference, their wings all held in an upright position, so that the beach looked as though variegated with beds of crocuses."

Instances, too, of their migrating in flocks are not unknown. Thus Professor Gibbes, of Charleston, in a trip one August day across the harbor, passed through a stream of them "six or eight yards wide, about as many high," which extended a hundred yards or more on each side of the vessel, all moving toward the southwest. Another observer, Professor Willett, of Macon, Ga., says that he saw the butterflies passing there in the autumn of 1878, moving from northwest to southeast. "About noon, when they were most abundant, there would be half a dozen visible all the time, crossing a fifteen-acre square in the city. They pursued an undeviating course, flying over and not around houses and other obstructions." He adds that "papers in southern Georgia noticed the great numbers passing at different points; and a friend in southern Alabama sent me specimens, saying that they were subjects of speculation there. About March, 1879, there was a similar migration from southeast to northwest, but in diminished numbers. I saw the fall migrations again in 1879, but in smaller numbers than in 1878. A lady of southern Georgia told me that her husband called her attention to the fall migration twenty-six years ago, and that she had observed it every year since."

The same phenomenon has been observed near the northern limit of its range on the New Jersey shore, where for several days in succession they were seen, flying along the margin of the coast over the water, all southward bound.

ANCYLOXIPHA NUMITOR — THE LEAST SKIPPER

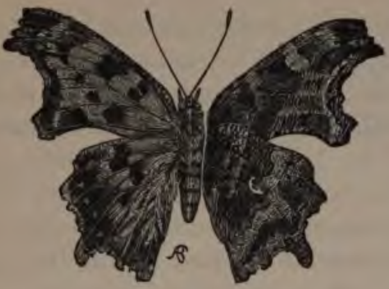
Except in its colors this butterfly resembles but little other Skippers; its simply clubbed antennæ, without an apical hook, its long, porrect palpi with the greatly produced apical joint, its feeble wings, and unusually slender body, all form characters which are in marked contrast to the uniformity of the smaller Skippers in these particulars. It is our smallest butterfly, its wings well rounded and dark brown above with the simplest fulvous markings.

It is widely spread both in the northern and southern States; in the latter it occurs from Florida, Georgia, and South Carolina to Texas; in the former its western extent is limited by eastern Kansas, Iowa, and Wisconsin, and its northern by southern Michigan, southern Ontario, and northern Ohio. In New York it has been found about Albany, and it has even been taken at Shefford, Quebec. It is abundant in the southern half of New England, but has only been recorded at a few localities north of Massachusetts, such as Milford and Webster, N. H., and Norway, Me., but it will probably be found nearly everywhere on search.

The eggs are laid freely by confined females, the month. The eggs of this brood hatch in from five to seven days, and the young caterpillar, as before, moults its embryonic skin in four days; as it is a comparatively rapid feeder, it probably passes the winter as a chrysalis rather than as a caterpillar.

The butterflies differ from all other members of the family to which they belong, in the feebleness of their flight and their general lack of vigor; their flight is even weaker than that of the Satyrids, and recalls them in its dancing movement. Never darting about from one spot to another, like the other Skippers, they move in a leisurely, languid manner, skipping over the grass-tops of a lane or among the reeds of a marshy rill, in the most dainty manner possible; they do not turn much to one side or the other, but fly with a short and slight vertical movement, apparently giving but a single beat of the wings to each little skip, and frequently stopping to alight; they never rise above the herbage unless to alight on a flower. They have a curious habit, when at rest, of moving their antennæ in a small circle, the motion of the two alternating; that is, when one is moving in a forward curve, the other is passing in a reverse direction.

The butterflies are fond of moist and hot situations, living beside streams through sunny spots, frequenting low, marshy meadows, and especially the borders of runlets through them, where they are half choked with wild grasses; or the moister spots of neglected bottom lands.



POLYGONIA COMMA — THE HOP-MERCHANT

We turn again to one of the Polygonias, three of which have already claimed our attention. This one much resembles the Violet-tip, but for its smaller size and generally livelier colors, and in having a silvery comma with expanded tips, instead of a semicolon, in the centre of the hind wings beneath. This mark will also distinguish it from the other species of similar size here mentioned, since in them the comma or L is not expanded at the tips. Like the Violet-tip, and in quite as marked a way, the males and females differ in coloring beneath, and as the species is also dimorphic in both sexes, it requires four specimens to represent at all the different forms the butterfly assumes, while there is considerable variation in each of the forms. The dimorphism is to a large extent — almost exclusively — seasonal, the first brood of butterflies being the darker, the autumn brood the lighter. The figure given here represents the male of the autumn brood.

It is one of our characteristic northern butterflies. It occurs as far south as West Virginia, North Carolina, Kentucky, and Tennessee, and west to Wisconsin, Iowa, Nebraska, and Kansas, and has even been reported from Texas. In the north it has been taken in various parts of Canada, especially toward the east, as on the north shore of Lake Superior, at Hudson Bay, at Ottawa, Montreal, and Quebec, as well as in Nova Scotia. It is found throughout New England, excepting in the White Mountain region and perhaps other elevated portions of the northern section; it has, however, been taken on Camel's Hump, Vt. But it is nowhere in New England a very common insect, excepting, perhaps, in the extreme south. It appears to be a somewhat local butterfly, but the cause of its restriction is unknown.

In but a single instance have I found a solitary egg of this butterfly; in all other cases they have been piled in isolated inverted columns varying from two to nine eggs, the average of those I have seen being a little over four. Very often several columns will be found on a single leaf, and these are probably laid by the same butterfly at one alighting, for the columns are frequently close together, separated sometimes by scarcely more than the width of an egg. They are almost always laid upon the under surface of leaves, though occasionally upon the stem of the plant selected, and in the case of the hop upon the tendrils. They gleam in the sun like dewdrops; they are pale green, barrel-shaped, but narrowed above with about eleven vertical ribs, which increase in height upward; they hatch in four or five days.

When it issues from the egg, the caterpillar has a shining black, rounded head, and a pale straw-colored body with half a dozen rows of long black bristles. At maturity these bristles are supplanted by bristly spines, and there is an added dorsal row, while the head is crowned by a pair of similar spines; the head is now green, and the body of a similar ground-color, with yellowish blotches. Its food consists of urticaceous plants, especially hop, nettle, and elm.

Although the egg at the summit of a column is the last of the series to be laid, it is the first to hatch, and the rest generally follow in due succession, there being a difference of many hours. All the caterpillars emerge on the same side of a column, and as they escape from one side of the crown of the egg, the column when emptied (for they do not eat more of the shell than is necessary to escape) has a gentle curve, tipped slightly in one direction by the movements of the escaping caterpillars. Immediately it is out of the egg, the caterpillar is long enough to coil twice around the interior of the egg, yet was coiled but once! Sometimes, after biting a hole large enough to escape, the inclosed caterpillar will rest motionless for a couple of hours. The great point is to get the head out; that done, the rest glides smoothly enough, toppling the column overhead. Once I watched the last one of a column make his entrance into the world; first he took a grand tour of his old home, spinning a thread (as they always do when young) all the way; then he walked to the top of the leaning, tottering tower, peered over into the empty crater of the egg at the summit, shuddered visibly, and turned cautiously on his course, now with winding and then with direct steps, until he reached the lowest egg, when he stretched himself to the utmost and fastened a thread to the leaf beyond, to which he then traveled. An hour was consumed in this performance. In early life the caterpillars eat little roundish holes in the middle of one side of the leaf, and, when their meal is over, rest with their tails close to the hole, their heads toward the midrib of the leaf.

Although a number are usually born on the same leaf, and several in one cluster, and, therefore, for at least a part of its life, it does not lack company, this caterpillar is in no way social, but strictly solitary from birth on. In early life it lives without concealment, except that it remains on the under side of a leaf. Later it draws the outer edges of the leaf together by silken threads enough to protect it partly from the light and the weather, and from this cover emerges to feed; it begins at the extremity of the leaf and consumes it evenly across until there is not enough left for shelter, when it passes to another leaf to construct a new one. It is just before entering on its third stage that it begins this mode of protection, and it effects its object by biting off the principal ribs of the base of the leaf on either side of the midrib, so as the easier to pull together the edges. Later, when grown stronger, it is able to pull them together without this precaution. This is when it feeds on leaves of some tender plant. If it be living on elm, which has a more refractory leaf, it accomplishes its purpose in a different way; the caterpillar bites a couple of channels on either side the leaf, starting a little distance from the base and cutting obliquely toward, but not to the midrib, through two or more of the lateral ribs; the corners of the flap thus formed of the larger part of the leaf are then fastened together by a few strands of silk, leaving the rest to flare open; when half eaten such leaves are shaped much like a saddle; within them one never finds more than a single inhabitant.

The angulated chrysalis closely resembles that of its allies of the same genus; it is pale wood-brown, tinged and streaked with pale green; the base of the tubercles along the back is of a metallic color, both in this species and in the Violet-tip (which it most resembles), and according to whether the color is silvery or golden, so will the price of hops (on which both are found) be low or high, according to the hop-growers; and so these chrysalids are termed Hop-merchants.

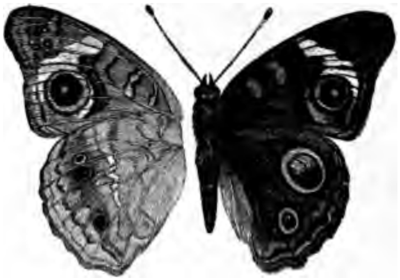
In New England this insect is double-brooded, the butterfly hibernating. The butterflies are seen all through the months of March, April, and the greater part of May, occasionally in June, few in number, and generally worn and faded. They lay eggs on the tender leaves of the hop and elm soon after their budding; the eggs hatch in four or five days; the caterpillars grow rather slowly, the chrysalis state continues from seven to eleven days, and they begin to transform to butterflies toward the end of June; they do not become abundant until the beginning of July, and a few stragglers emerge from the chrysalis as late as the middle of the month; these fly throughout August and later. The eggs are again laid late in July and throughout August, and the second brood begins to appear about the 25th of August; they continue to emerge from the chrysalis until the latter part of September, and evidently hibernate without much delay, as they become scarce by the end of the month and are rarely seen in October. In one instance, however, some late caterpillars I found on nettle changed to chrysalis as late as October 9, and the butterfly appeared October 27.

Further south, the species is triple-brooded. Edwards says that in West Virginia the hibernating females lay their eggs the last of April, or early in May, and the first brood of butterflies emerges from the chrysalis about the 1st of June. The second laying of eggs occurs in the last half of July, and the butterflies from these appear the last of August or the first of September. Eggs are again laid in September, and the resultant butterflies appear in October. The middle brood is composed of both forms mingled, the spring and the autumn.

These butterflies are very wary insects with a quick, nervous flight, yet at the same time audacious even to pugnacity, darting recklessly at and about objects in the air, vainly pursuing even passing birds or dragon flies, and tussling with each other to such an extent that their wings are almost invariably rubbed and ragged in a short time after eclosion. They show, says one writer, "the most perverse disregard of all measures of safety. . . . When disturbed very roughly, they will take a zigzag trip over a tree, or a housetop, or a fence, and often, without alighting anywhere, return to the old spot within six inches. Many times have I put my hands on the coveted spot and had the little [fellow] light upon them."

A pair of them may sometimes be seen perched at some distance apart, sunning themselves on a rock, stone wall, or dead and fallen branch of a tree; suddenly one quits its station, the other following instantaneously; as if electrified by a common impulse, they dash at each other, dart hither and thither, whirl about, and then as suddenly whisk back, each to its own spot, twist about in a final flourish of satisfaction, and quickly resume the gentle fanning of their wings.

The butterfly frequents roads, especially in damp places, or collects in some numbers on damp stones by forest brooks, not crowded together, but scattered about in close neighborhood, with wings outspread to receive the full benefit of the sun.



JUNONIA CŒNIA — THE BUCKEYE

This butterfly has the upper surface of the wings blackish-brown, marked with orange patches and with peacock-eye spots. It is the only butterfly we have which has such markings above, and the only extratropical species of a genus which extends throughout the tropics of both worlds. This species also extends into the tropics, for it is found in Cuba and Haiti, and throughout Mexico and Central America to Colombia. Within the southern United States it extends from Atlantic to Pacific, and has even invaded the vexed Bermudas, islands almost bereft of butterflies. The northernmost points from which it has been reported (leaving New England for the moment out of account) are Long Island, Staten Island, New Jersey, Newburgh, N. Y., several stations in southern Ontario, Dayton, Ohio, northern Illinois, and Wisconsin, the Rocky Mountains just north of our boundary, Truckee, Nev., and San Mateo, Cal. It is exceedingly rare in New England, but has been taken in a number of scattered localities, all or nearly all by the seashore or in the valley of the Connecticut: in Connecticut, about New Haven, Farmington, Hartford, and Norwich; in Rhode Island at Newport; in Massachusetts in the Connecticut valley at Springfield, Granby, and Amherst, on Cape Cod at Barnstable and Falmouth Heights, at Taunton and Sharon, and at half a dozen points about Boston; in New Hampshire at Hampton Beach and Portsmouth; and in Maine at Cape Meddock, Portland, and even Bangor. In one or two instances it has been said to be common, as in 1897 at Hartford, Conn., and Sharon, Mass.

The eggs are laid singly on the tip and under side of the leaves of the food-plant, and hatch in four days; they are dome-shaped, with ten rather high and thin vertical walls, and dark green in color. The caterpillar is cylindrical and spiny, the spines rather short, with a pair of spines surmounting the head; it is dark gray with broken longitudinal stripes of pale yellow at the sides and otherwise flecked and dotted with orange. It spins no web, but feeds openly, at first upon the under surface, rejecting the ribs of the food-plant, selecting Gerardia and a few other plants, mostly Scrophulariaceæ. The chrysalis, like the caterpillar, resembles in a general way that of *Vanessa cardui*, and hangs from seven to seventeen days, according to the season; it is brown, with dusky shades more or less mottled with black and cream color; when attacked by parasites, however, it becomes wholly golden, the tubercles with a slight umber hue.

The butterfly has a very erratic flight, usually consisting of a few fluttering strokes of the wings, followed by an idle sail, rarely more than a foot above the ground, but when startled its flight is rapid, strong, and enduring. It is fond of the flowers of the golden-rod, and frequents the open country, being found alike in meadows and in dry arid spots.

There are several broods in a season in the south, the butterfly hibernating. At least butterflies are found throughout the winter in western Florida, and they have been taken in eastern Florida in February, March, and April. The eggs must be laid early in the spring, for the butterfly just from chrysalis has been recorded in Georgia on May 4, and in South Carolina as early as April 8. In central Florida, the butterfly has been reared June 23 from eggs laid May 18 (probably the second brood of the season at that point), and again on July 16 from eggs laid June 11. Another summer brood is indicated by caterpillars and chrysalids obtained in Alabama the last of August, from which butterflies emerged early in September, and Dr. Chapman, of Appalachicola, had one emerge there September 9. Perhaps there is still another brood, for Abbot in Georgia bred a butterfly on October 14 after a fortnight in chrysalis; but according to Dr. Chapman, a careful observer, the autumn brood does not become numerous until early in October, and butterflies continue to emerge until the middle of that month, and are abundant until November. Eggs are laid in Missouri about the middle of August.

It is possible that there are two broods at the north; as the butterfly has been found in New England by far most frequently in the latter half of August and in September, there is every reason to believe that here, too, the butterfly hibernates; and the number of specimens taken, and the occasional capture of a July butterfly in a fresh condition, suggest that the butterfly sometimes survives the winter here, and that the July butterflies are their descendants; of a wintered brood, however, there are no signs whatever, the earliest capture known to me being July 16. Probably all the August butterflies belong to this brood. It is possible, indeed, that there is but a single brood in New England, the later fresh specimens being the laggards of a butterfly that has ventured too far north. No caterpillars have yet been detected in New England. But it seems to me most probable that all the July and early August specimens are immigrants from farther south, and the September brood the only one born in New England, except, perhaps, in its southernmost portions, along the very edge of the sea; in that case we must suppose that all the northern hibernators perish. The fact that a specimen has been taken in July as far north and east as Bangor, where it can scarcely be believed to be indigenous (or it would have been seen again), the absence of an early spring brood of overwintering specimens and the powers of flight of the butterfly seem to make the migration hypothesis the more probable ; against it there is only the freshness of some of the July butterflies.

LAERTIAS PHILENOR — THE BLUE SWALLOWTAIL

THE large and magnificent butterfly with which we conclude this volume is of an intense black, shading off into brilliant and metallic tints of glossy green and steel color, as the light strikes across the wings. The hind wings have a single tail, and near the border of both wings is a series of large, pale greenish spots. Beneath, the fore wings are duller in color, but the outer half of the hind wings is more brilliant and variegated than above, the spots being larger and changing in part to deep orange, while others at the margin are straw-colored. It stands apart from our other native Swallowtails, and approaches more nearly in structure the gigantic Ornithopteras of the East Indies, which, with the Morphos of South America, are the pride of the omnivorous collector. The males have the inner margin of the hind wings reflected to form a fold in which the male scent scales are concealed, which give forth a very faint musk-like odor.

It is a southern butterfly, and its allies are all tropical. In our southern States it is found from ocean to ocean, and reaches into Mexico, where it is found from the sea level to a height of 7000 feet as far south as the state of Puebla. On the Pacific coast it is found as far north as San Francisco at least, but it appears to be absent from the vast intervening area between California and the Mississippi valley, except along the Mexican border. In the Mississippi valley and eastward it occurs as far north as Iowa, Wisconsin, Illinois, Ohio, southern Ontario, southern New York, and Long Island. In these northernmost localities it is usually rare, and may sometimes not be seen for years, and then suddenly appear in considerable numbers. This is the case in New England, where it has never been found north of Massachusetts, and in this State on the eastern seaboard only, as far north as Beverly.

The butterfly has not a powerful flight, but flies slowly and near the ground. It is particularly fond of flowers, and may sometimes be found clustering on them in vast numbers, and drinking nectar until their bodies seem ready to burst.

The eggs are nearly globular, and covered with a red waxy secretion in vertical ridges, which give them somewhat the appearance of a diminutive melon. They are laid in little bunches, usually of about a dozen, in two or three rows, generally nearly touching one another, but sometimes a considerably larger number, on leaves, or more generally on the smaller stems or tendrils of the food-plant; they hatch in from seven to nine days. In one instance observed, the butterfly, after selecting a leaflet at the extremity of a stem, alighted on it, stood with legs stretched straight beneath her, and "bending down the end of the abdomen to the stem of the leaflet, deposited an egg upon it; she continued to deposit the eggs one after another in straight rows, with intervals between the eggs and the rows equal to the diameter of the egg, and in so doing curved the abdomen quite around to the

opposite side of the stem until the latter was half encircled with eggs."

When born, the caterpillars are cylindrical and dark brown, with several rows of conical warts, most of them bearing a single bristle, a few more than one. When full grown the color and shape are the same, or nearly the same, but the bristles and most of the warts have disappeared, and in their place, or near their place, are a lesser number of rows of fleshy filaments, growing progressively longer toward the two extremities of the body, and there is a row of coral red spots on either side; the pair of filaments just behind the head is of excessive length. Their principal food-plant is the dutchman's pipe, Aristolochia, but they are also found on Ipomœa and some kinds of Polygonum.

They do not devour the shell of the egg more than is necessary to escape from it, and then at once move to the edge of the leaf, where they range themselves side by side with their heads to the edge. One which I separated from its brethren directly after hatching, and placed upon a leaf by itself, retired after feeding to near the middle of the upper surface of the leaf, and returned to the edge to feed. Shortly afterwards it crawled to the under surface, and behaved in the same way. With another for companion I placed it on the upper surface of a fresh leaf, and both traveled to the under surface, and rested there side by side, head to head, or head to tail indifferently. They spin but very little silk, but without that little have great difficulty in retaining their hold on anything but the upper surface of a horizontal leaf. Although gregarious in earliest life and semigregarious for some time afterward, they distribute themselves, when full grown, anywhere over the foliage, and live separate lives, often denuding whole vines. The odor from their osmateria is very slight.

The chrysalids are ordinarily of a dark reddish dead-leaf color, but occasionally wholly green; the body is greatly expanded near the middle, and besides a pyramidal projection in the middle of the back of the thorax the abdomen bears a pair of compressed high ridges.

In the north the insect is double-brooded, and appears to hibernate as a butterfly, though sometimes as a chrysalis. The earliest record of its appearance is toward the middle of May; in central California it appears by the first of April, in the south early in March. In the middle States the eggs are laid at the end of May, and hatch in from seven to nine days. In the south caterpillars of the first brood are matured by the end of April, and the chrysalids hang from ten to fourteen days. In California the caterpillars of this brood change to chrysalis all through May and June, and the chrysalis state lasts three weeks or more, occasionally a little less. In the northeastern States young and full-grown caterpillars may be found in the middle of June, and the first butterflies from their chrysalids, which sometimes hang for only ten days, appear in July, and lay their eggs the latter part of the month; the young caterpillars may be found early in August, and generally attain maturity by the last week in August; the chrysalids hang from twenty-four to twenty-seven days, so that the hibernating butterflies make their appearance during the last week of September. Sometimes, however, the chrysalids go over to the next year. In New England the caterpillar state lasts from three to four weeks, but late in the season is very much prolonged by cold weather. In West Virginia it lasts but a fortnight, and Mr. Edwards thinks that there are many broods there from early spring to frost. In central California it is believed to have but two broods, the last of May and in August.

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The Riverside Press
CAMBRIDGE, MASS., U. S. A.

OTHER WORKS ON BUTTERFLIES

By

SAMUEL HUBBARD SCUDDER

CAMBRIDGE, MASS.

The Butterflies of the Eastern United States and Canada, with special reference to New England.

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Fossil Butterflies. Memoirs of the American Association for the Advancement of Science. i. 4to, 100pp., 3 plates, paper, $2.00. *Published by the American Association for the Advancement of Science, Salem, Mass.*

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